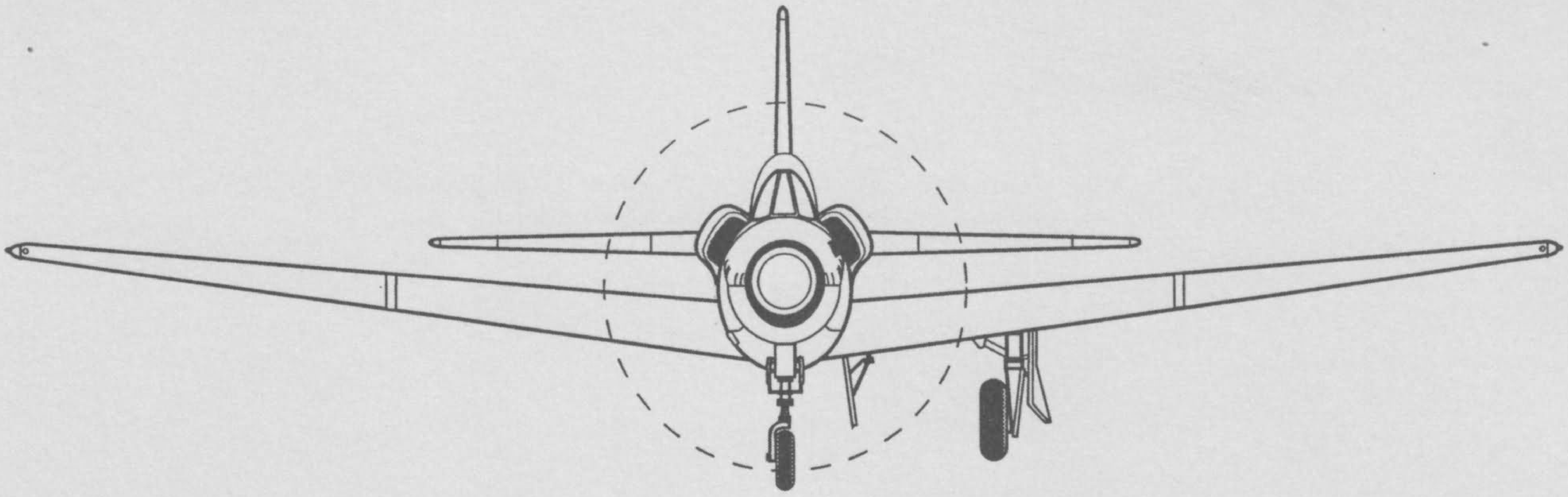
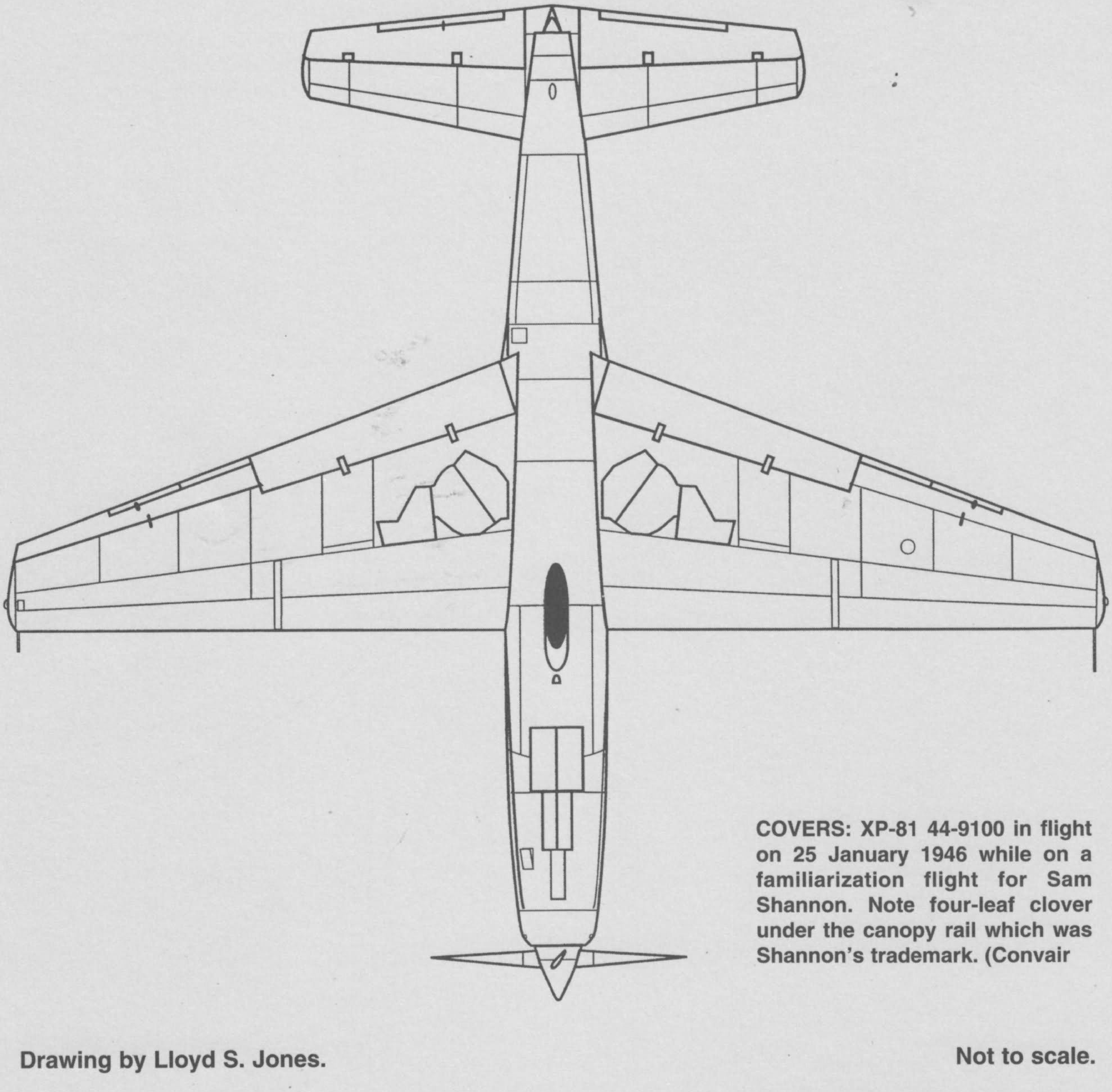
AIR FORCE LEGENDS NUMBER 214

CONSOLIDATED VULTEE

XP-81

BY STEVE GINTER





COVERS: XP-81 44-9100 in flight on 25 January 1946 while on a familiarization flight for Sam Shannon. Note four-leaf clover under the canopy rail which was Shannon's trademark. (Convair

Drawing by Lloyd S. Jones.

Not to scale.

CONSOLIDATED VULTEE XP-81 ESCORT FIGHTER

BACKGROUND

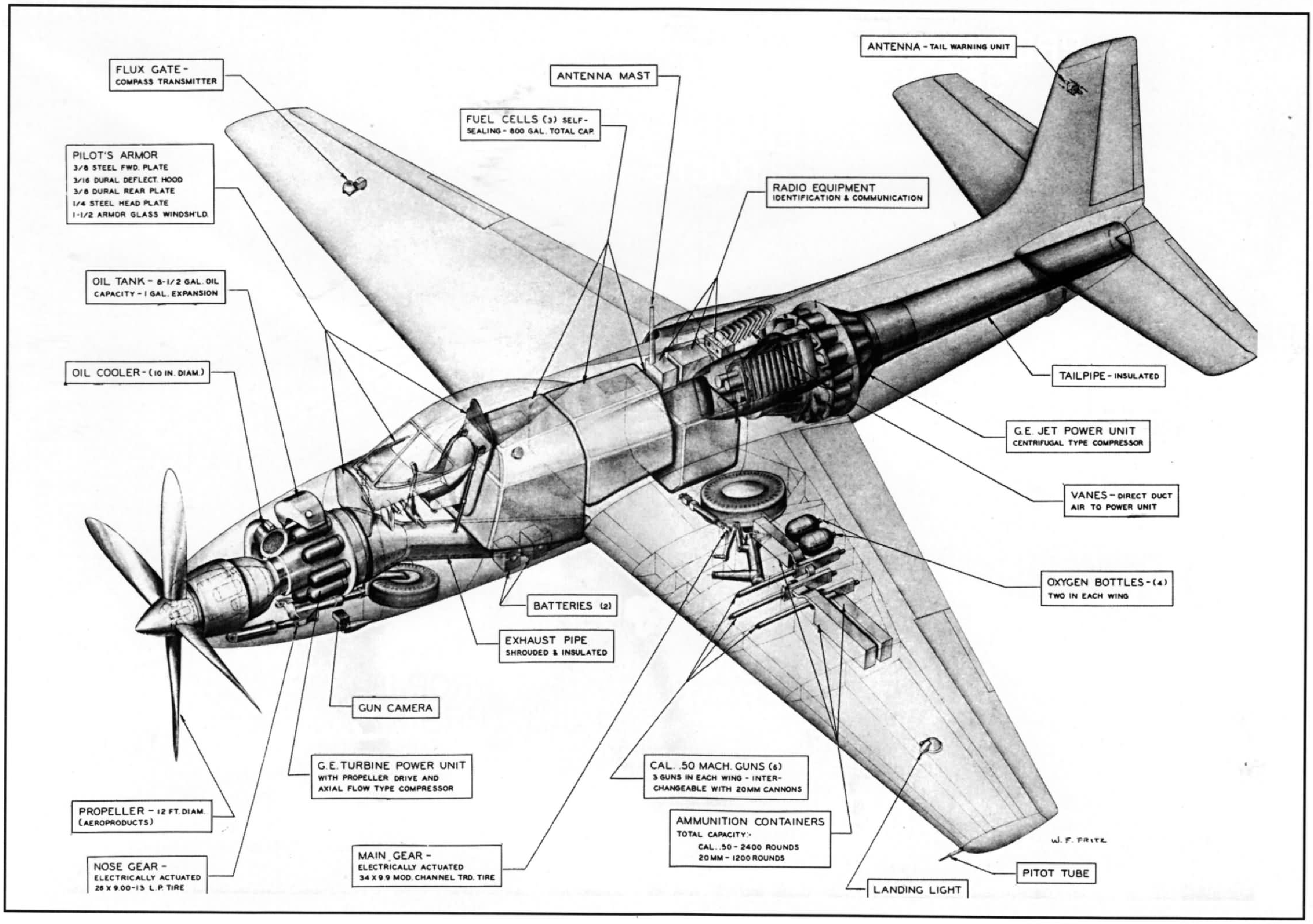
In the summer of 1943, it became apparent that the USAAC would need a high-altitude, high-speed, long-range, heavy fighter to provide fighter escort for the new B-29 Super Fortress then under development. Published requirements were: 1,250-mile operating radius plus fuel for 20-minutes of combat and a reserve supply for landing; a cruising speed of 250 mph at 25,000 feet; maximum speed over 500 mph and a combat ceiling of 37,500 feet; a climb rate of 2,500 fpm at 27,000 feet; two engines for reliability and a 12° angle of vision over the nose. One option proposed to the industry by the AAC was the use of a turboprop engine for long-range capabilities coupled with a jet engine for high-speed combat performance.

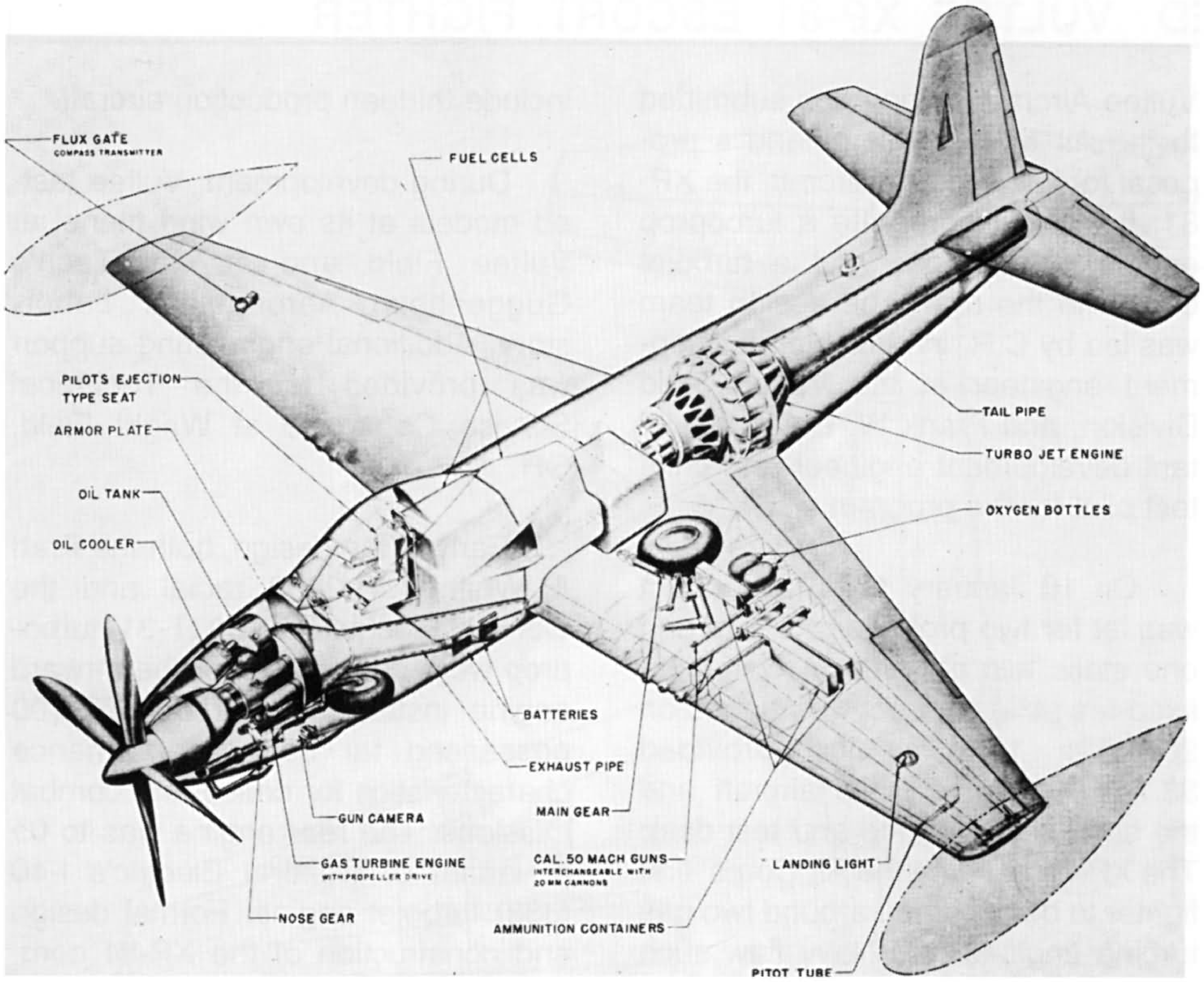
In September 1943, Consolidated Vultee Aircraft Corporation submitted to the Air Material Command a proposal for just such an aircraft, the XP-81. It would incorporate a turboprop engine in the nose and a turbojet engine in the rear. The design team was led by C.R. Irvine, chief development engineer at the Vultee Field Division, and Frank W. Davis, assistant development engineer and chief test pilot for the program.

On 18 January 1944, a contract was let for two prototype XP-81s and one static test airframe. A cost-plus-fixed-fee (4%) contract was signed on 20 July 1944, which provided $3,744,000 for the two aircraft and the static test airframe and test data. The XP-81 became the Air Corps' first fighter to be designed around two gas turbine engines (the Navy flew such an aircraft, the Ryan DarkShark, in 1945-46; see Naval Fighters #28). The contract was later modified to include thirteen production aircraft.

During development, Vultee tested models at its own wind tunnel at Vultee Field and at Cal Tech's Guggenheim Aeronautical Laborstory. Additional engineering support was provided by the Technical Service Command at Wright Field, OH.

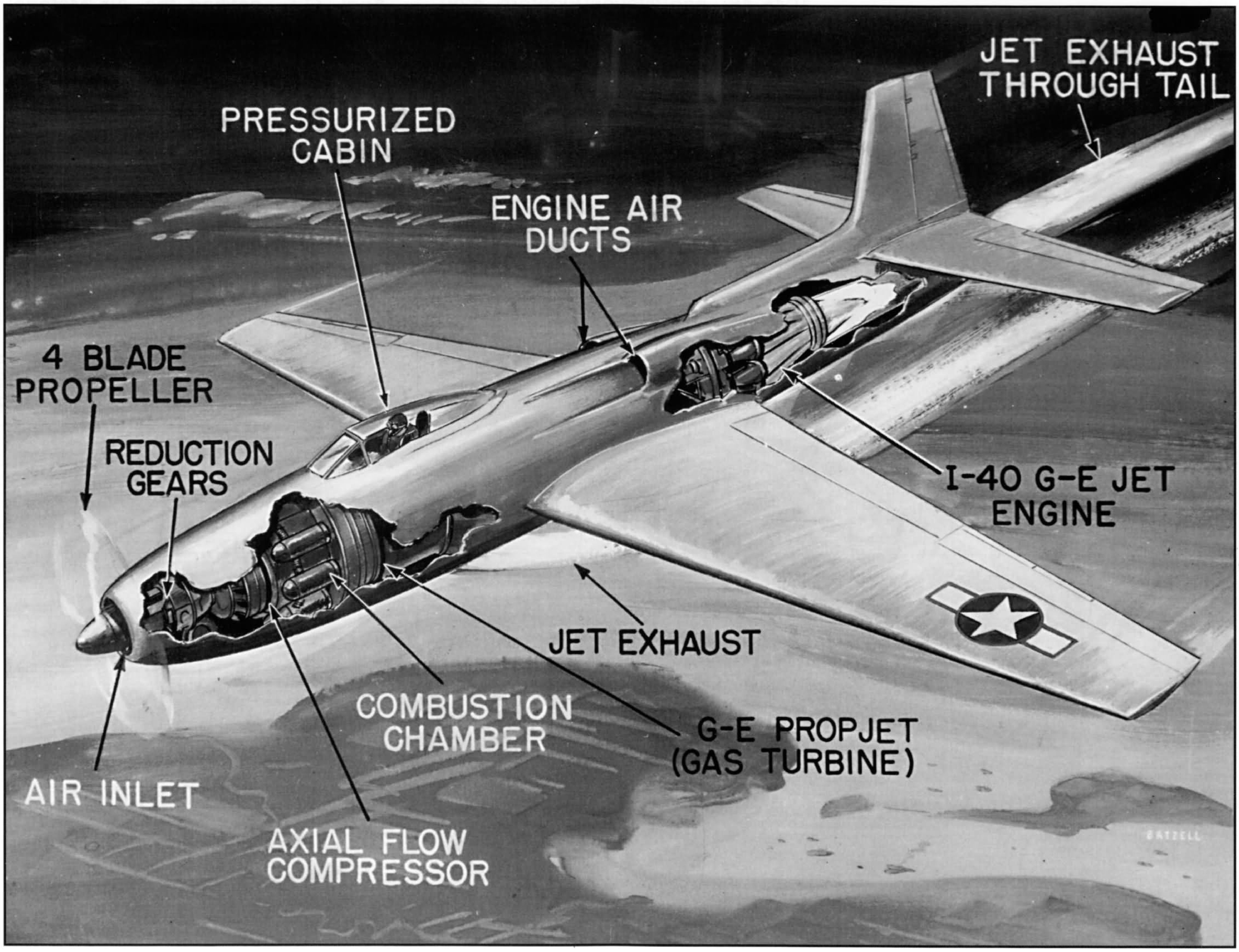
Early in the design, both the Pratt & Whitney R-2800 radial and the General Electric TG-100 (T-31) turboprop were considered for the forward engine installation, but the TG-100 possessed far better performance characteristics for cruise and combat missions. The rear engine was to be a variant of General Electric's I-40 (J33) turbojet engine. Formal design and construction of the XP-81 commenced on 20 January 1944, but in April, G.E. notified the Air Material Command that difficulties with the

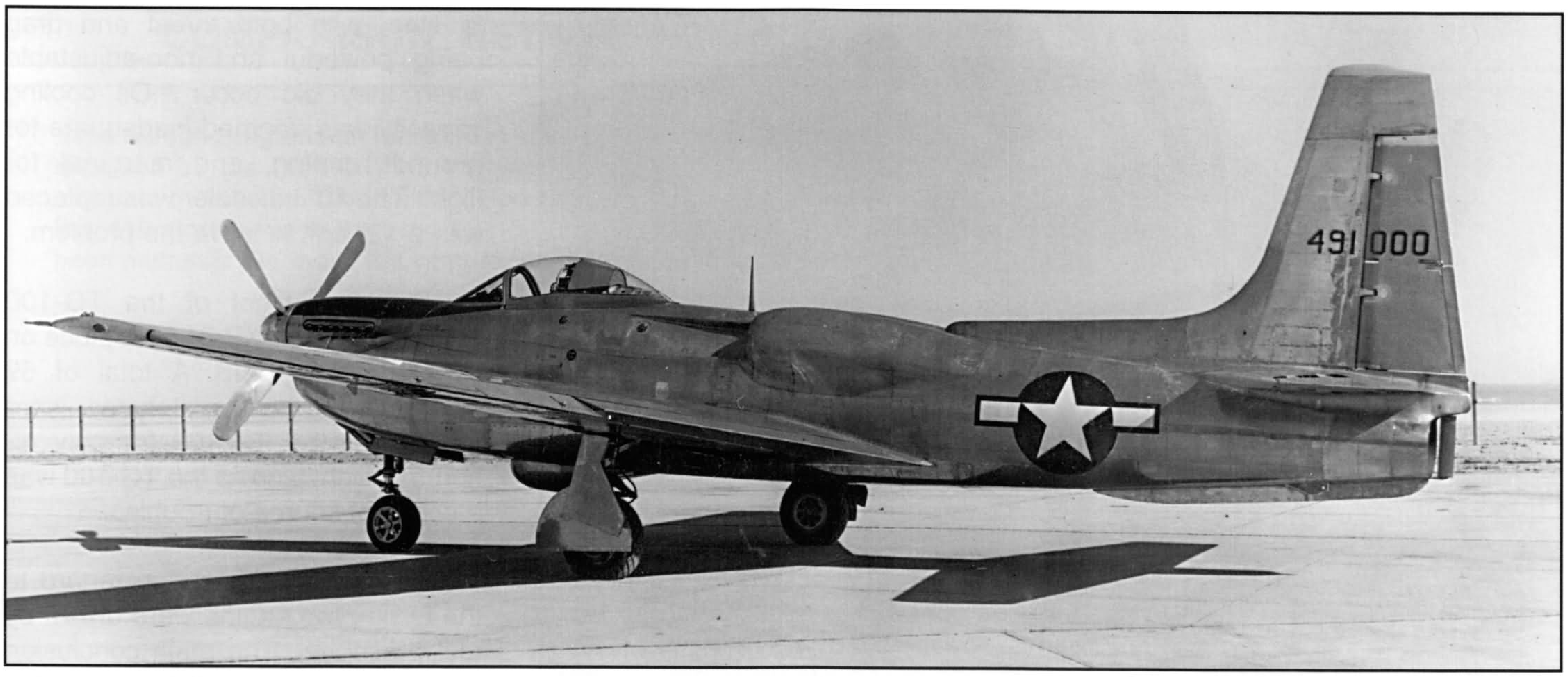

FLUX GATE - COMPASS TRANSMITTER
ANTENNA MAST
FUEL CELLS (3) SELF-SEALING - 800 GAL. TOTAL CAP.
ANTENNA - TAIL WARNING UNIT
PILOT'S ARMOR
3/8 STEEL FWD. PLATE
3/16 DURAL DEFLECT. HOOD
3/8 DURAL REAR PLATE
1/4 STEEL HEAD PLATE
1-1/2 ARMOR GLASS WINDSH'LD.
RADIO EQUIPMENT IDENTIFICATION & COMMUNICATION
OIL TANK - 8-1/2 GAL. OIL CAPACITY - 1 GAL. EXPANSION
OIL COOLER - (10 IN. DIAM.)
TAILPIPE - INSULATED
G.E. JET POWER UNIT CENTRIFUGAL TYPE COMPRESSOR
VANES - DIRECT DUCT AIR TO POWER UNIT
OXYGEN BOTTLES - (4) TWO IN EACH WING
BATTERIES (2)
EXHAUST PIPE SHROUDED & INSULATED
GUN CAMERA
G.E. TURBINE POWER UNIT WITH PROPELLER DRIVE AND AXIAL FLOW TYPE COMPRESSOR
CAL. .50 MACH. GUNS (6) 3 GUNS IN EACH WING - INTERCHANGEABLE WITH 20MM CANNONS
AMMUNITION CONTAINERS TOTAL CAPACITY:- CAL. .50 - 2400 ROUNDS 20MM - 1200 ROUNDS
PROPELLER - 12 FT. DIAM. (AEROPRODUCTS)
NOSE GEAR - ELECTRICALLY ACTUATED 26 X 9.00-13 L.P. TIRE
MAIN GEAR - ELECTRICALLY ACTUATED 34 X 9.9 MOD. CHANNEL TRD. TIRE
W. F. FRITZ
PITOT TUBE
LANDING LIGHT



At left, early general arrangement cutaway with large volume tip tanks with TG-100 turbo-prop and I-40 Turbojet engines. (Convair) Below, stylized promotional illustration of the XP-81. (Consolidated Vultee)

TG-100 would result in delivery delays. By June, an alternate engine was sought for use in the flight-test program. The engine installed was a Packard-built V-1650-3 Rolls-Royce Merlin engine. The Air Corps provided a quick engine change unit from a North American P-51D Mustang and within one week of receipt the necessary structural and cowling modifications were made. The original 11' 2" diameter Hamilton Standard propeller was tested as was a 12' Aeroproducts propeller. The Merlin installation increased weight by 950 pounds, pro-



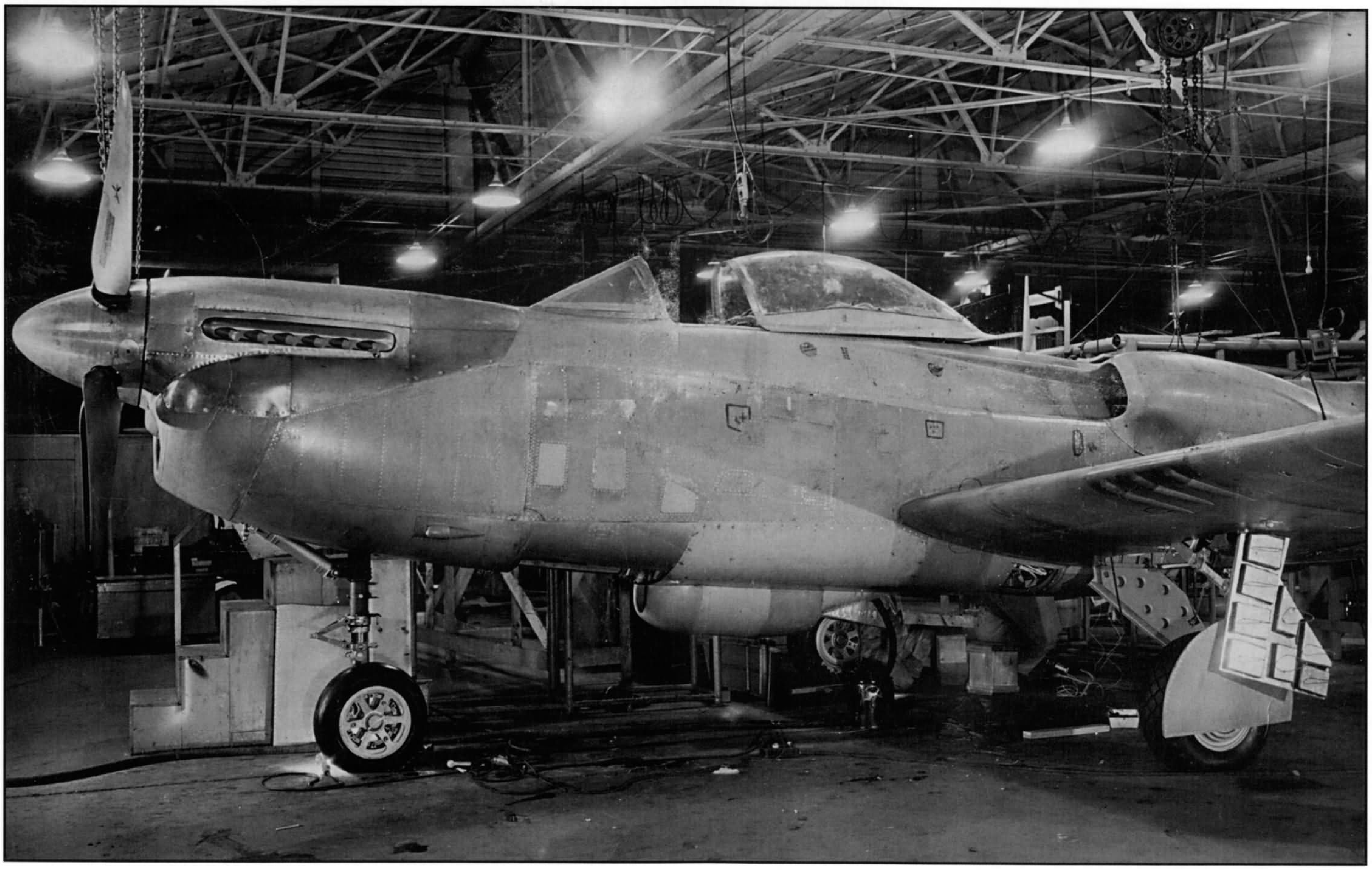


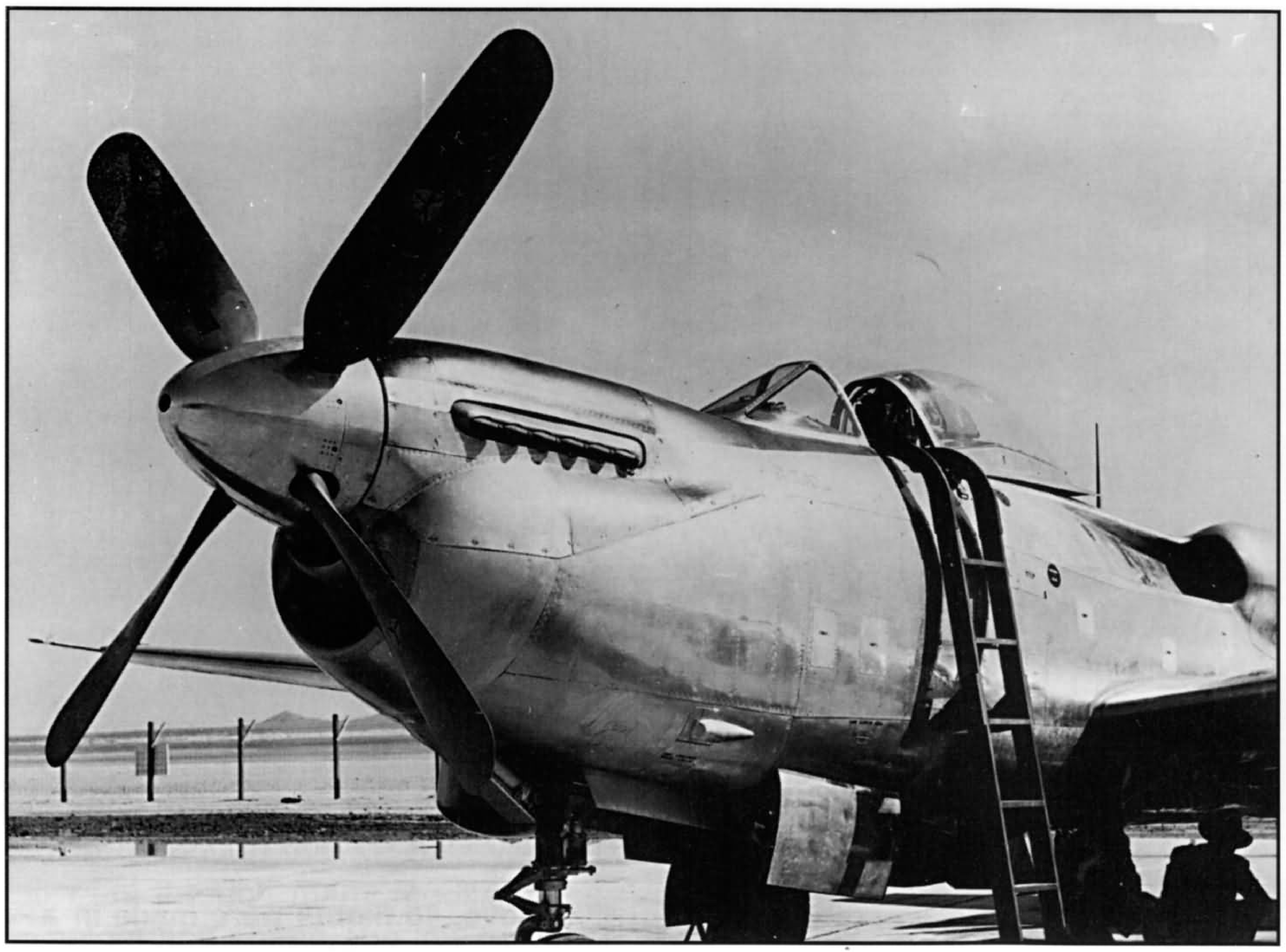
duced 960 less horsepower at takeoff and 1,720 hp less at top speed.

The XP-81 equipped with the I-40 and the Merlin engine first flew on 7 February 1945. The Merlin was used through 18 May 1945 when the TG-100 became available. With the Merlin engine installed, the XP-81 completed 46 flights and accumulated 47.75 flight hours. Two engine related problems manifested themselves during this phase of the testing: poor directional stability at low speeds due to torque of the Merlin engine, and the throwing of oil by the Aeroproducts propeller against the windscreen.

The XP-81 with the TG-100 installed returned to Muroc on 11 June

Above, 46 flights were made in XP-81 SerNo 44-91000 with the interim Merlin engine in nose. Note small ventral fin and large vertical fin tip extension fitted on 2-21-45 and 2-22-45 to control the Merlin's torque. (Convair) Below, Merlin installation being finalized at the Vultee plant. An oil-cooling airscoop was fitted on the belly in place of the TG-100 exhaust duct. (Convair)



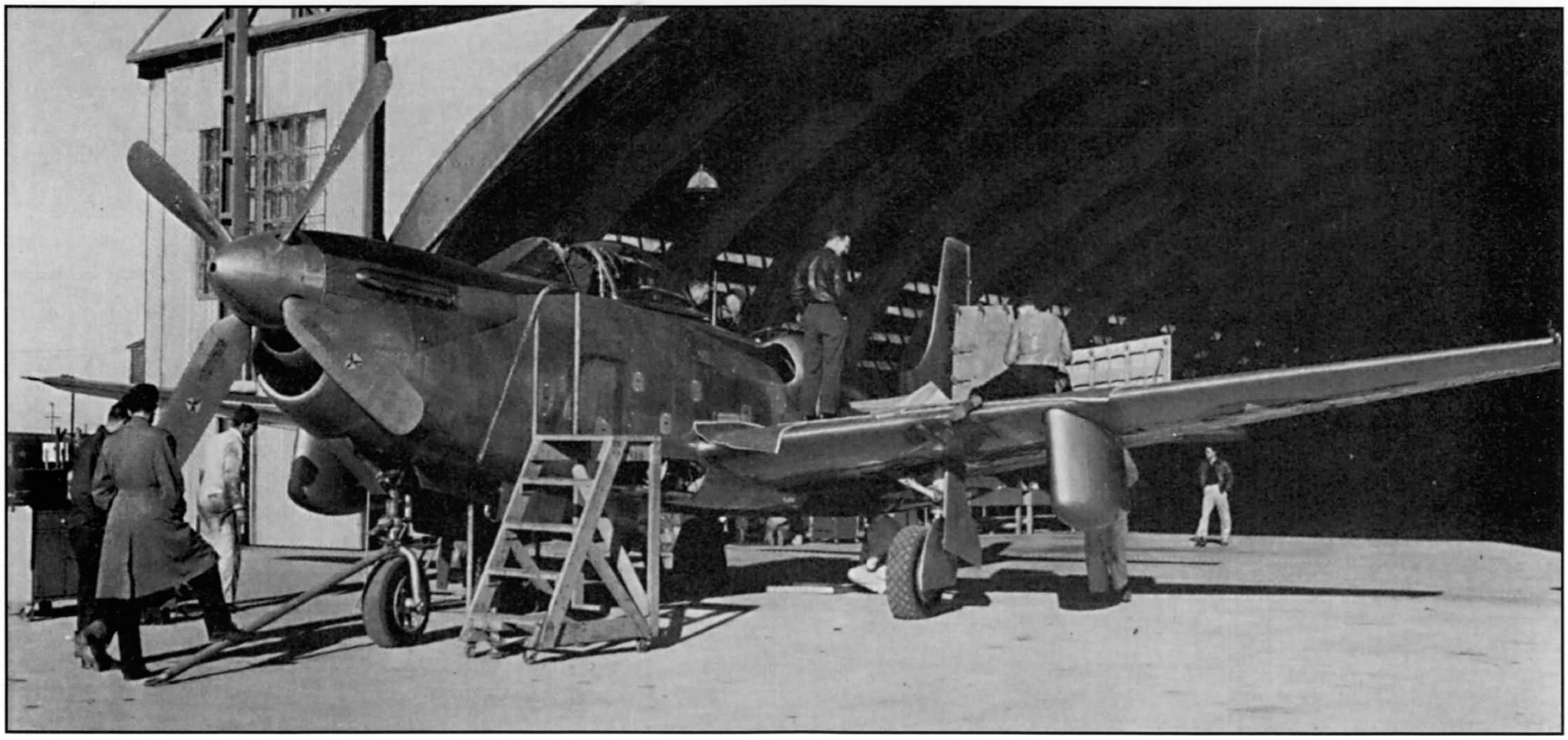


Above, Merlin-fitted XP-81 on the ramp at Muroc. The tip of the right wing slipper tank can be seen behind the nose gear leg. (Convair) Below, good view of the Merlin equipped XP-81 with wing mounted slipper tanks at the factory. Note open gun and ammo doors on the upper wing. (Convair)

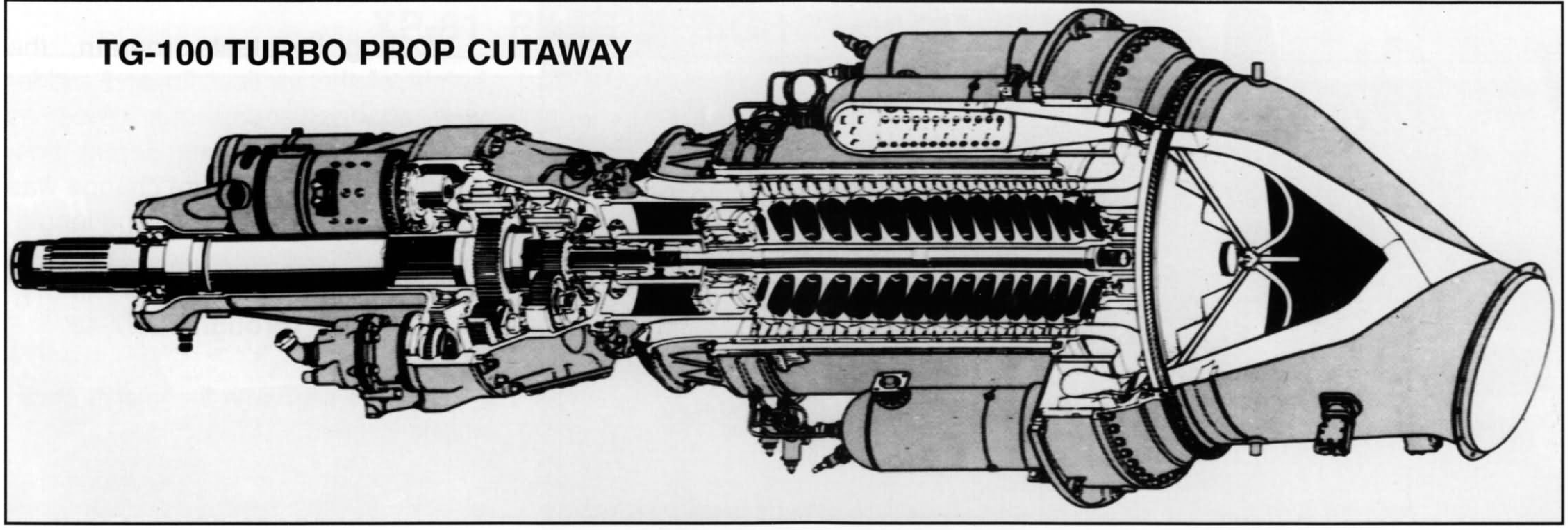
1945. Extensive ground testing of the installation was conducted from 23 June through 20 December 1945. Throughout the ground testing, propeller control problems plagued the XP-81. The engine itself proved difficult to start and turbine wheel replacements were frequent (.5 to 39.5 hours of use). The engine and propeller combination had a serious throttle lag problem. Frank Davis, assistant development engineer and chief test pilot for the program, stated that: "The pilot had about a 10-second lag when he wanted to go and about 2-seconds lag when he wanted to stop, with both thrust and drag being powerful and non-adjustable when they did occur". Oil cooling capacity was deemed inadequate for ground running, and marginal for flight. The 10" oil cooler was replaced with a 12" unit to solve the problem.

The first flight of the TG-100 engine equipped XP-81 took place on 21 December 1945. A total of 69 flights in the two prototypes were made with the TG-100 for only 42 hours of flight time as the TG-100 was a constant source of trouble.

Several conclusions in regard to the turbo-prop engine were drawn by test personnel. The main conclusion was that current propeller and related gear systems were inadequate for use with gas turbine engines. Test personnel recommended: the development of new standards of propeller balancing so that the inherent smoothness of the gas turbine engine could be fully utilized; re-study of requirements for rate-of-pitch change to guard against excessive torque loads, using a governor responsive to torque rather than to the number of revolutions per minute; automatic emergency feathering; a topping governor sensitive to temperature; as well as improved starting ease and increased service life for turbine wheels.



TG-100 TURBO PROP CUTAWAY



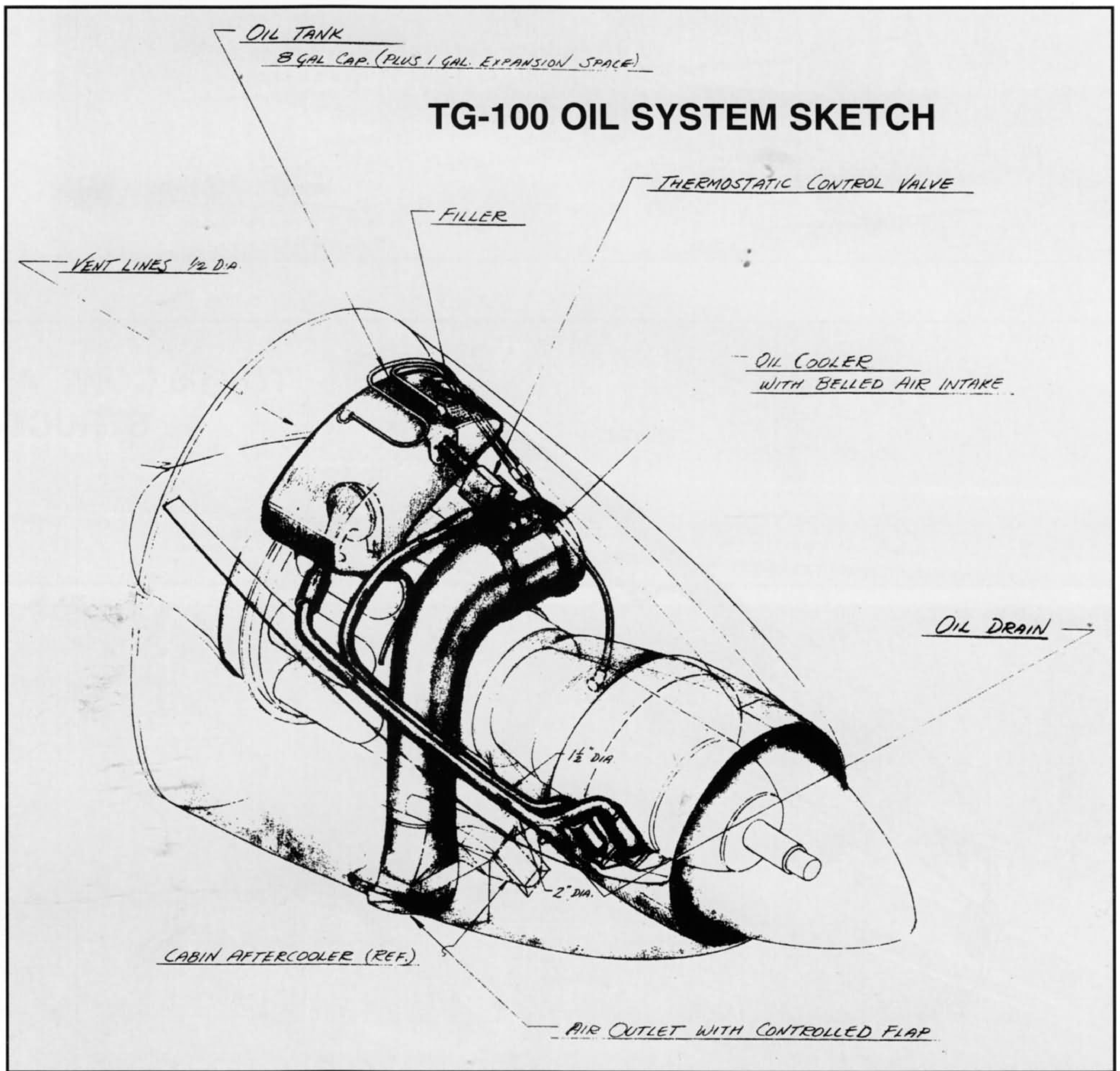
TG-100 DESCRIBED

The General Electric TG-100 engine was a gas turbine which drove a constant speed, variable pitch propeller through a train of reduction gears (11.35:1). Most of the energy released by the exhaust gases was transmitted by the turbine through the propeller shaft, but some of the energy was also emitted in the jet exhaust as propulsive thrust. Weight of the TG-100-A was 1,839 lbs.

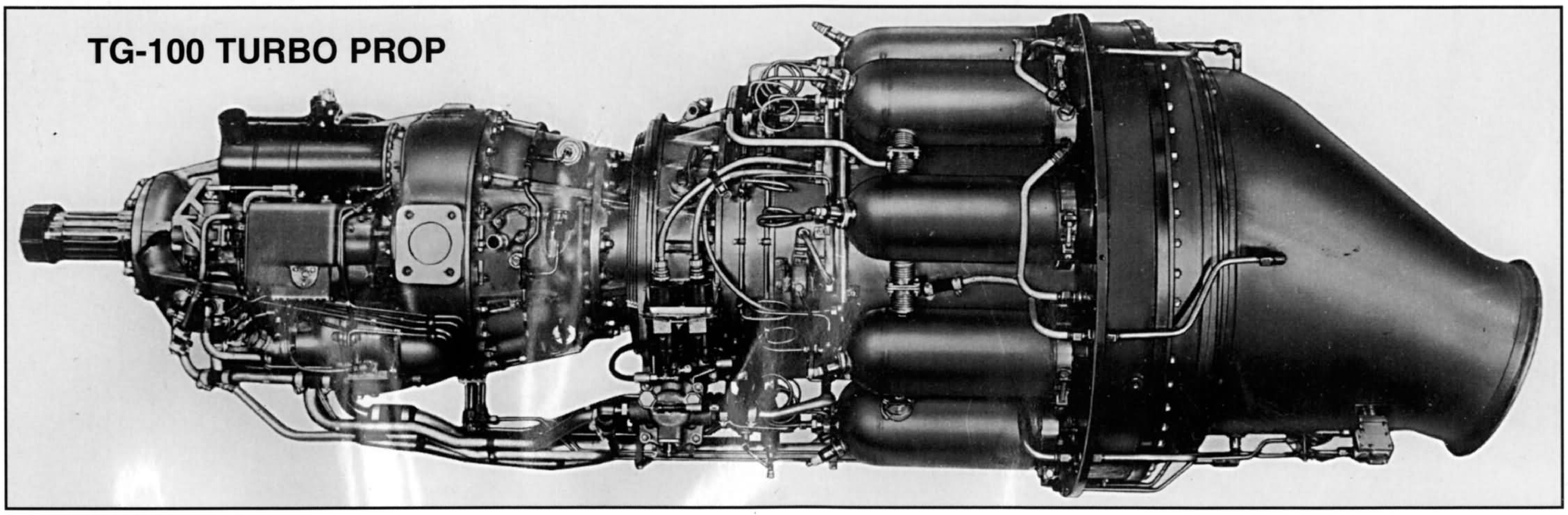
The XP-81 contract specified that the TG-100 was to produce 2,200 shp (G.E. promised 2,300 shp) of which the TG-100A only produced between 1,470 and 1,650 shp during the flight test program. The TG-100B was scheduled for the 13-production P/F-81s and based on the TG-100A's performance was expected to only produce 1,700 shp.

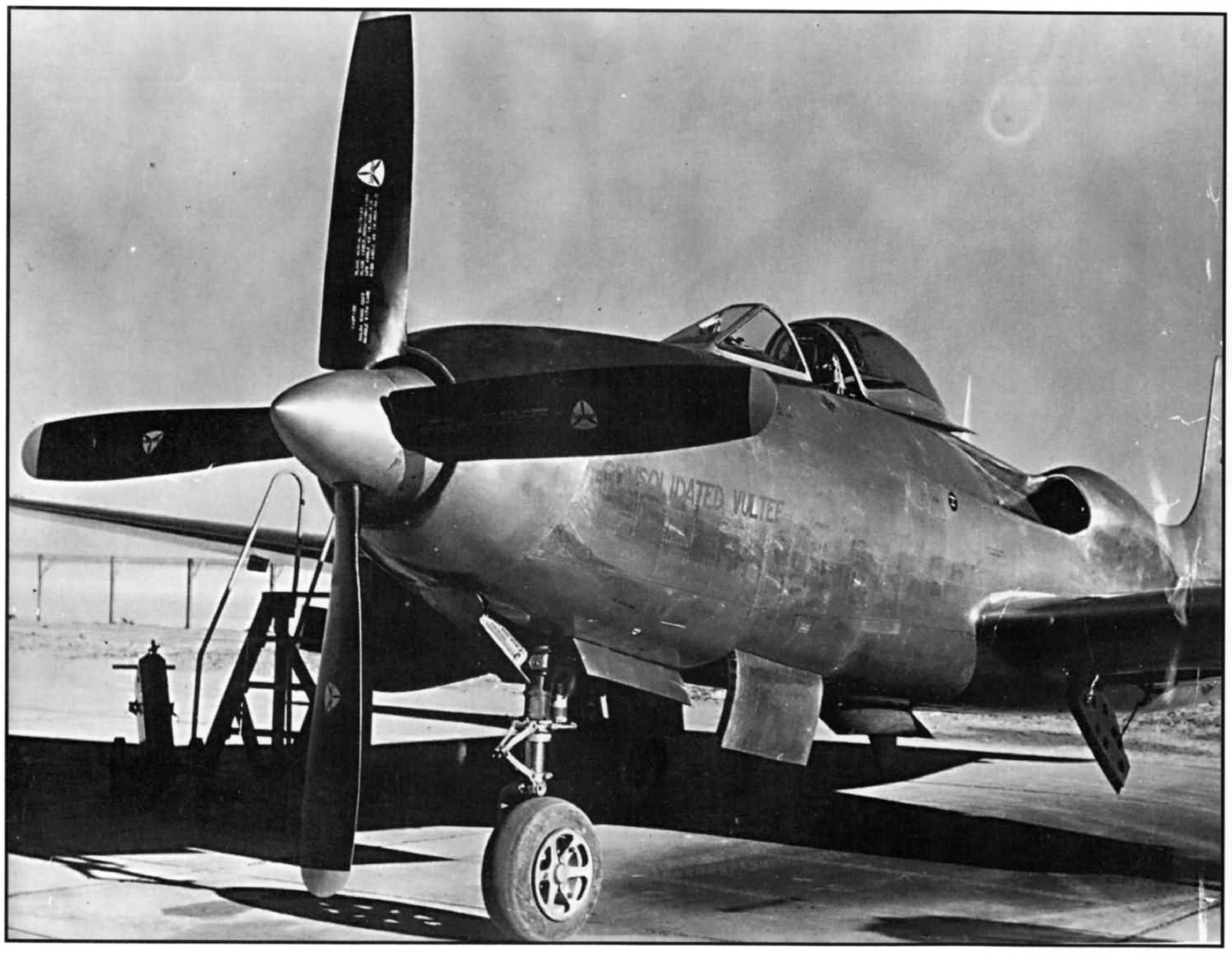
At right, 11 May 1944 sketch of the TG-100 oil system shows general installation of the engine and spinner. (Convair)

TG-100 OIL SYSTEM SKETCH



TG-100 TURBO PROP





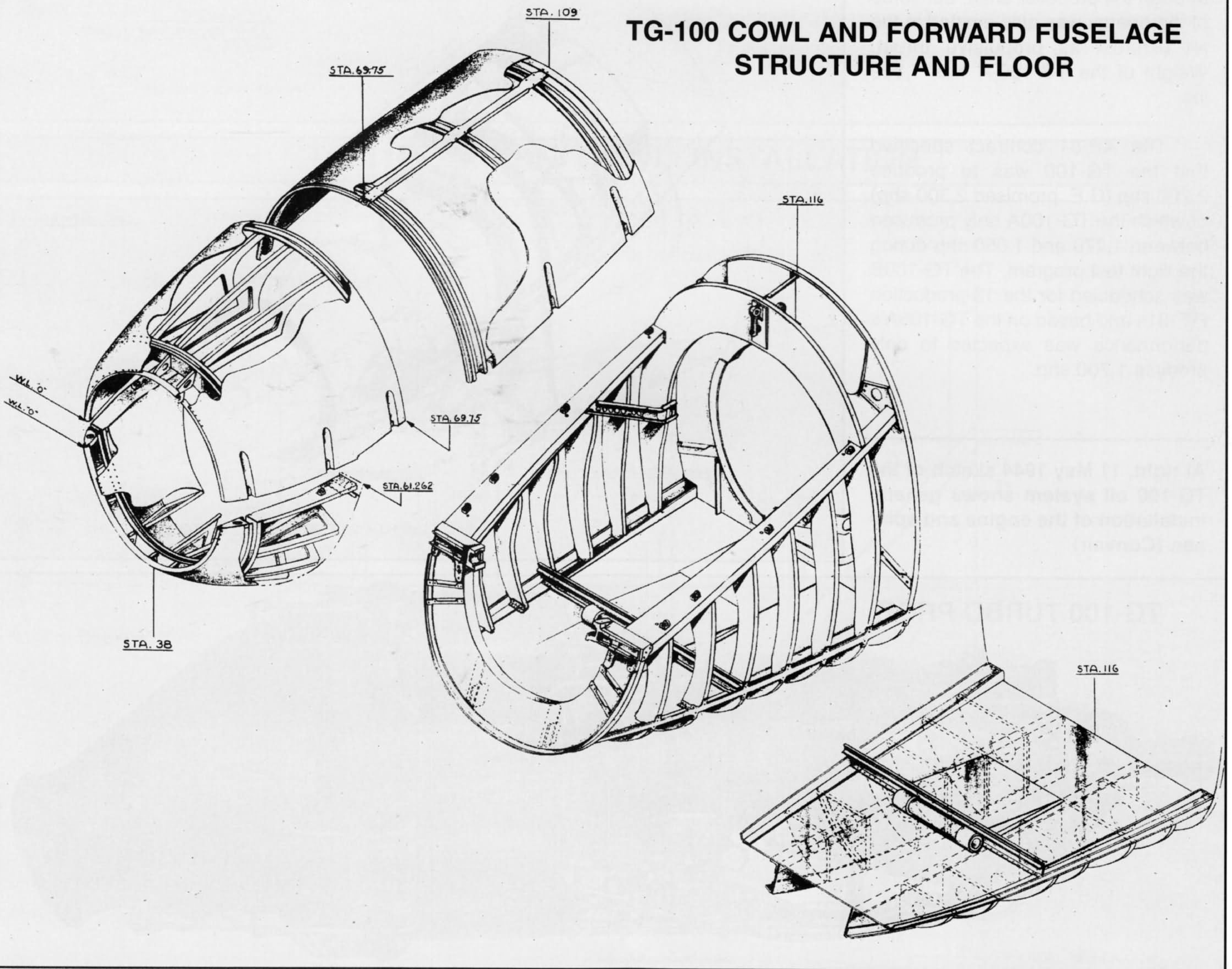
During the test program, the height of the vertical fin and rudder was changed numerous times as were the ventral and dorsal fins. Another area of constant change was the I-40 tail pipe diameter and length.

Ground and flight tests summary 02-07-45 through 12-17-46

Flights 1-46 were with the interim Merlin engine installed.

At left, TG-100 turbo-prop installation with Aeroproducts propeller prior to first flight of the engine in December 1945. Consolidated Vultee was painted on the nose. (Convair)

TG-100 COWL AND FORWARD FUSELAGE STRUCTURE AND FLOOR



02-07-45 to 02-10-45

Flights 1-3. Initial flight, general flight characteristics, engine operations, climb, level flight, and stalls.

02-11-45 to 02-12-45

Inspected tailcone of I-40 for cracks. Incorporated 5° antiboost, reset prop pitch stops, reworked counters in right hand photo recorder, canopy recorder and pilot's panel.

02-13-45

Flight 4 explored longitudinal stability, climb, speed and engine operation.

02-14-45 to 02-15-45

Inspected propeller for oil leak, inspected I-40 engine, removed oscillograph boxes, removed U.H.F. radio.

02-16-45 to 02-20-45

Flight 5-9 explored the propeller, climb, lateral stability, cooling, speed, stalls, elevator gradient, directional control and single engine operation.

02-21-45 to 02-22-45

Reworked belly cowl under the I-40 unit. Installed addition to the vertical fin and added ventral fin. Installed external wing boxes and yaw meters. Loosened all fuel lines and inspected same. Conducted brake check.

02-23-45 to 02-24-45

Flight 10-12 explored directional and lateral stability, airspeed calibration and speed runs.

02-25-45 to 03-05-45

Calibrated instruments, reworked aileron and trailing edge, installed turning vane on the tail pipe, repaired carburetor air duct, installed Mircarter guides on canopy frame, installed new instrumentation. Inspected I-40 engine, added rudder seal, clean and polished airplane, weighed airplane to determine fuel tank capacities. Heat blanket added to the tailcone.

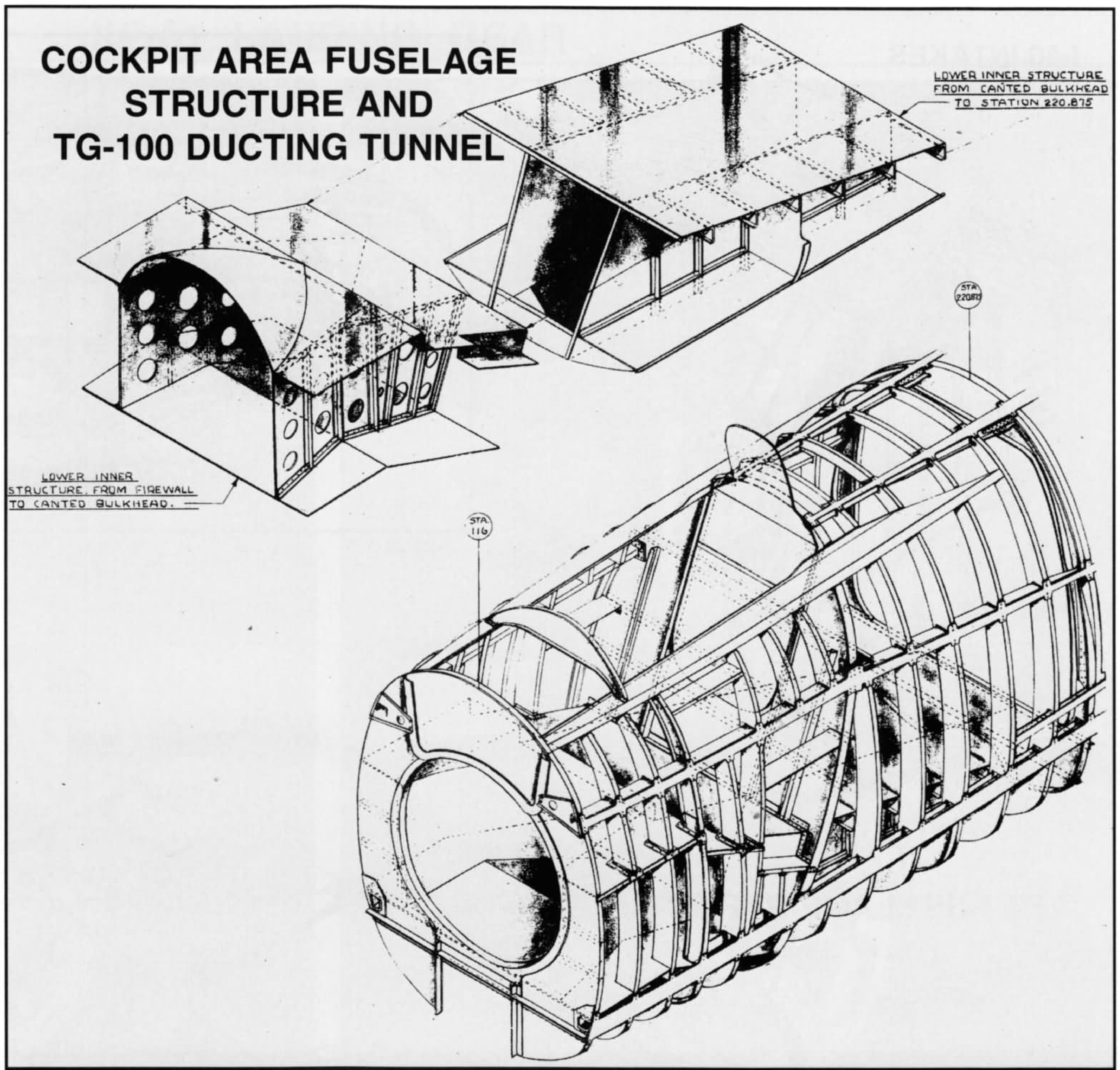
03-06-45 to 03-10-45

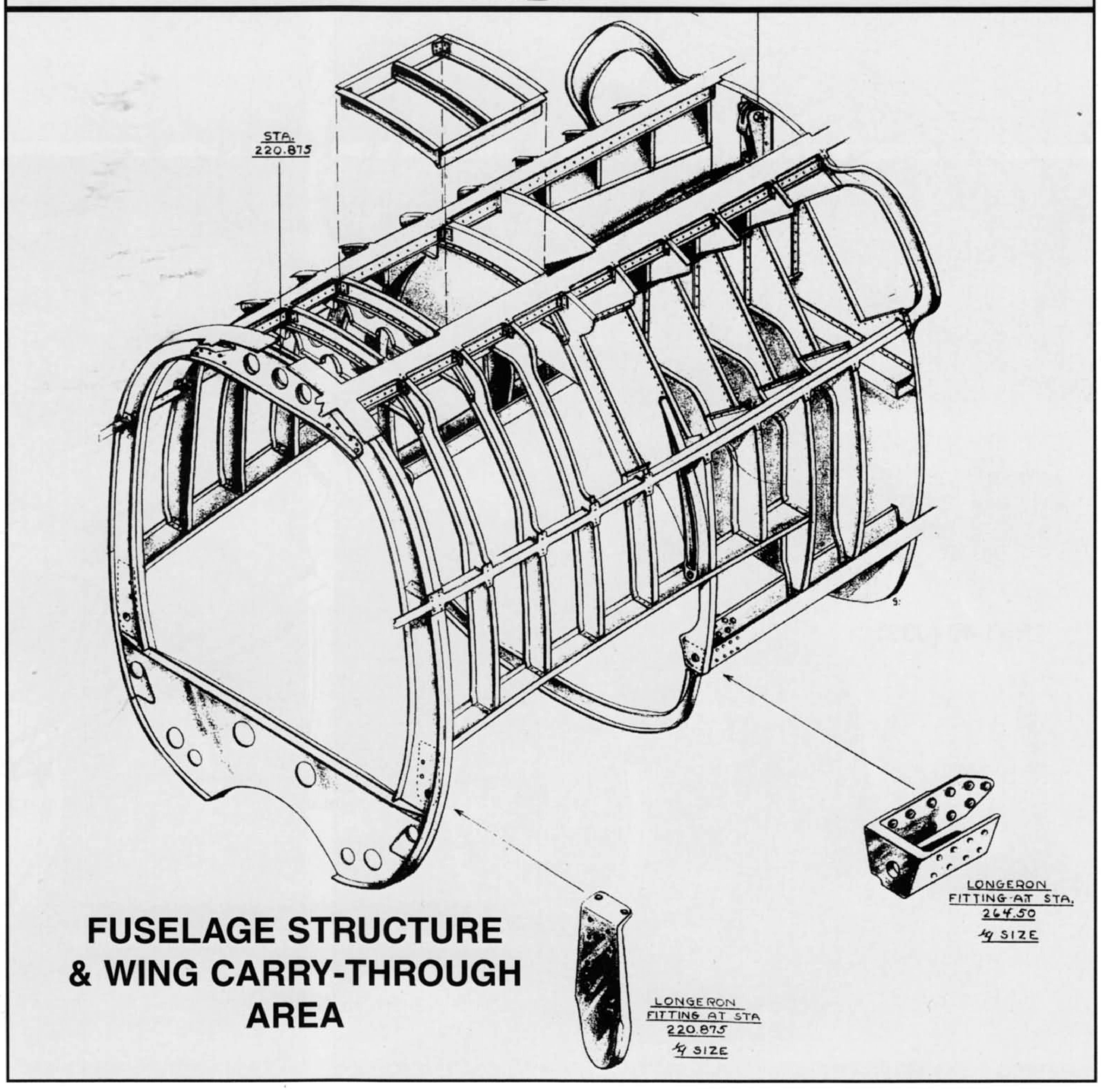
Flights 13-19 explored cooling, directional stability, airspeed calibration and speed runs. Initial flight by AAF pilot.

03-11-45 to 03-23-45

Reworked shroud at factory (Vultee Field). Reworked propeller as per Aeroproducts rep., reworked fin and rudder, changed plumbing for wing recorder, inspected barometer and oil pump per G.E. rep., reworked I-40 door spring clips.

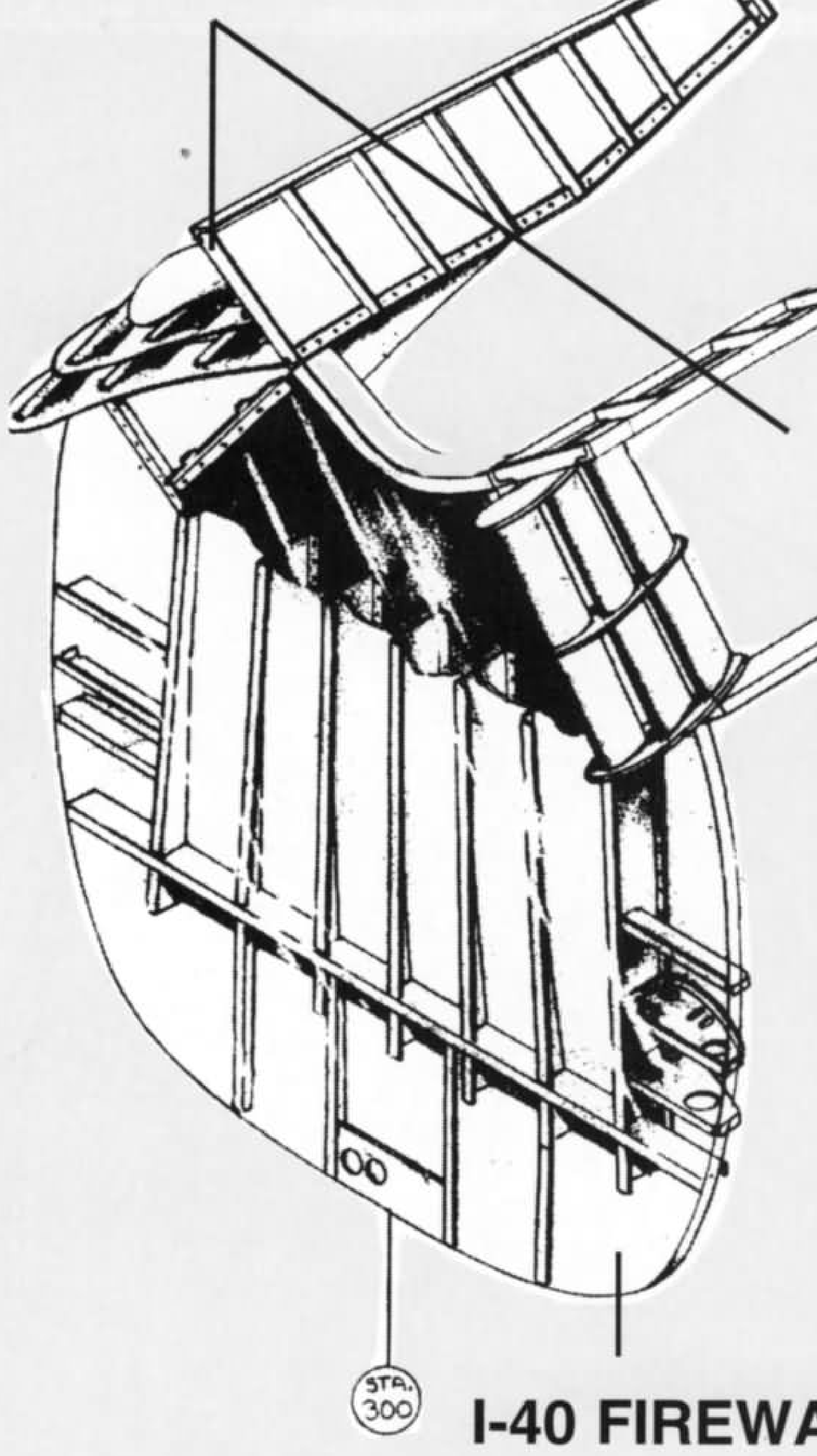
COCKPIT AREA FUSELAGE STRUCTURE AND TG-100 DUCTING TUNNEL


LOWER INNER STRUCTURE FROM CANTED BULKHEAD TO STATION 220.875
STA 220.875
STA 116
LOWER INNER STRUCTURE FROM FIREWALL TO CANTED BULKHEAD.

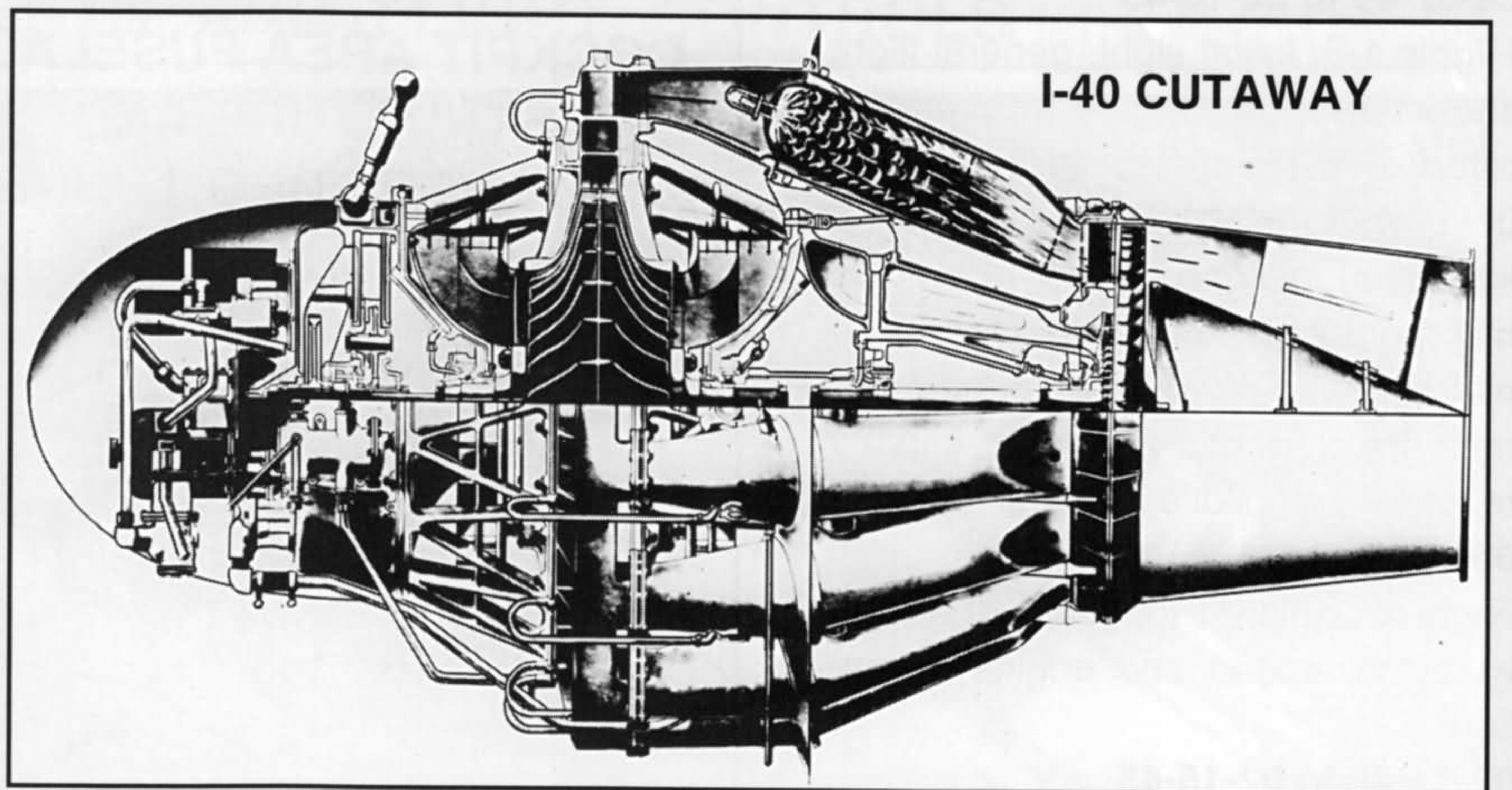

STA. 220.875
LONGERON FITTING AT STA. 264.50
1/4 SIZE
LONGERON FITTING AT STA 220.875
1/4 SIZE

FUSELAGE STRUCTURE & WING CARRY-THROUGH AREA

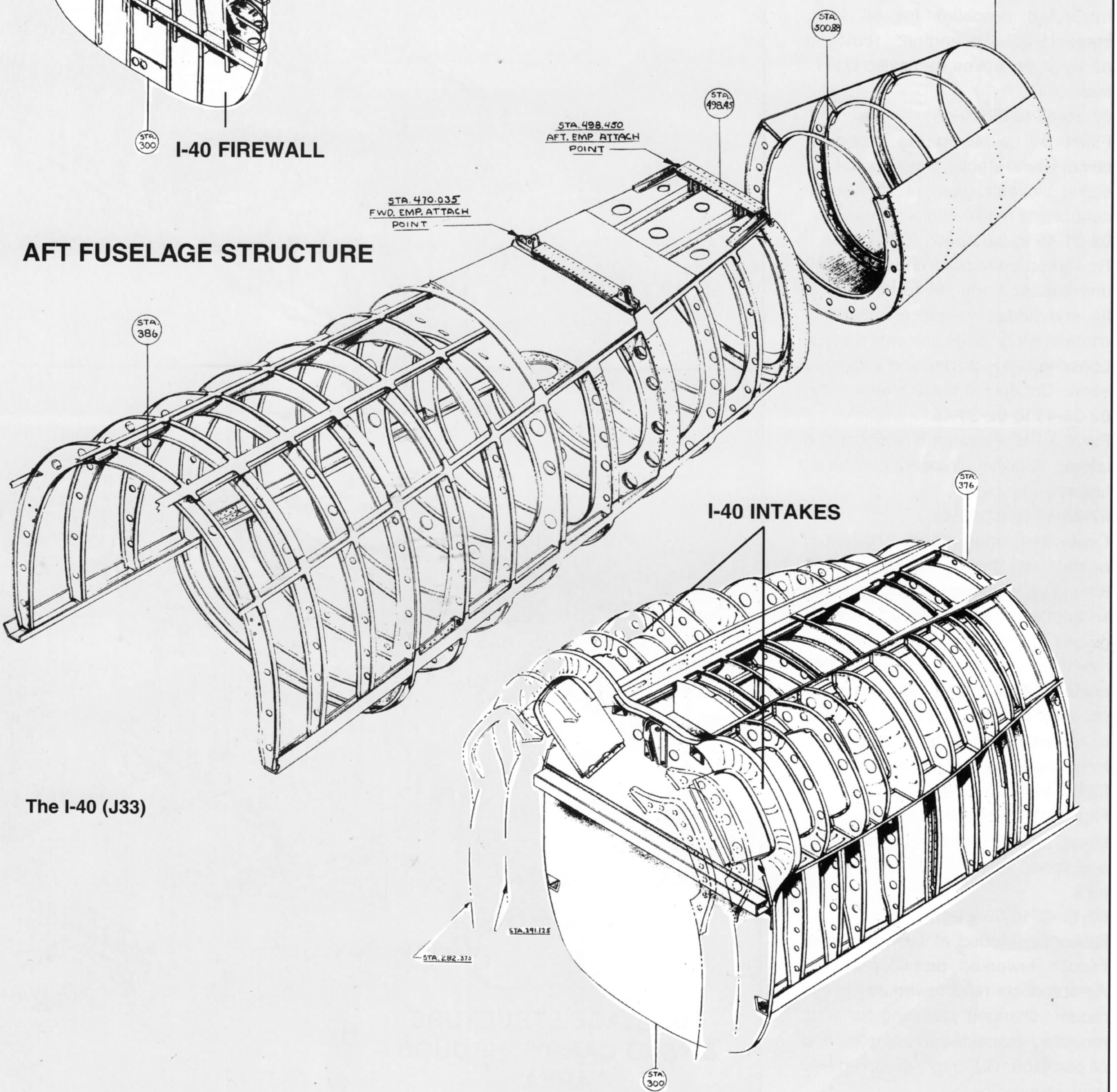
I-40 INTAKES



I-40 FIREWALL



I-40 CUTAWAY



AFT FUSELAGE STRUCTURE

The I-40 (J33)

03-24-45 to 03-27-45
Flights 20-24 explored directional and lateral stability, speed runs, climb, cooling and general flight characteristics.

03-28-45 to 03-29-45
Installed rudder force and stick force transmitters, installed guard on canopy operating crank, changed spark plugs in Merlin engine, shortened drop control lever, checked zero readings on elevator and rudder position.

03-30-45
Flight 25 explored longitudinal and directional control, speed and climb performance.

03-31-45 to 04-03-45
Reworked rudder and elevators, installed two vertical steel sighting posts on top fin, removed inboard landing gear doors and revised to E.O. 102-006001 #2.

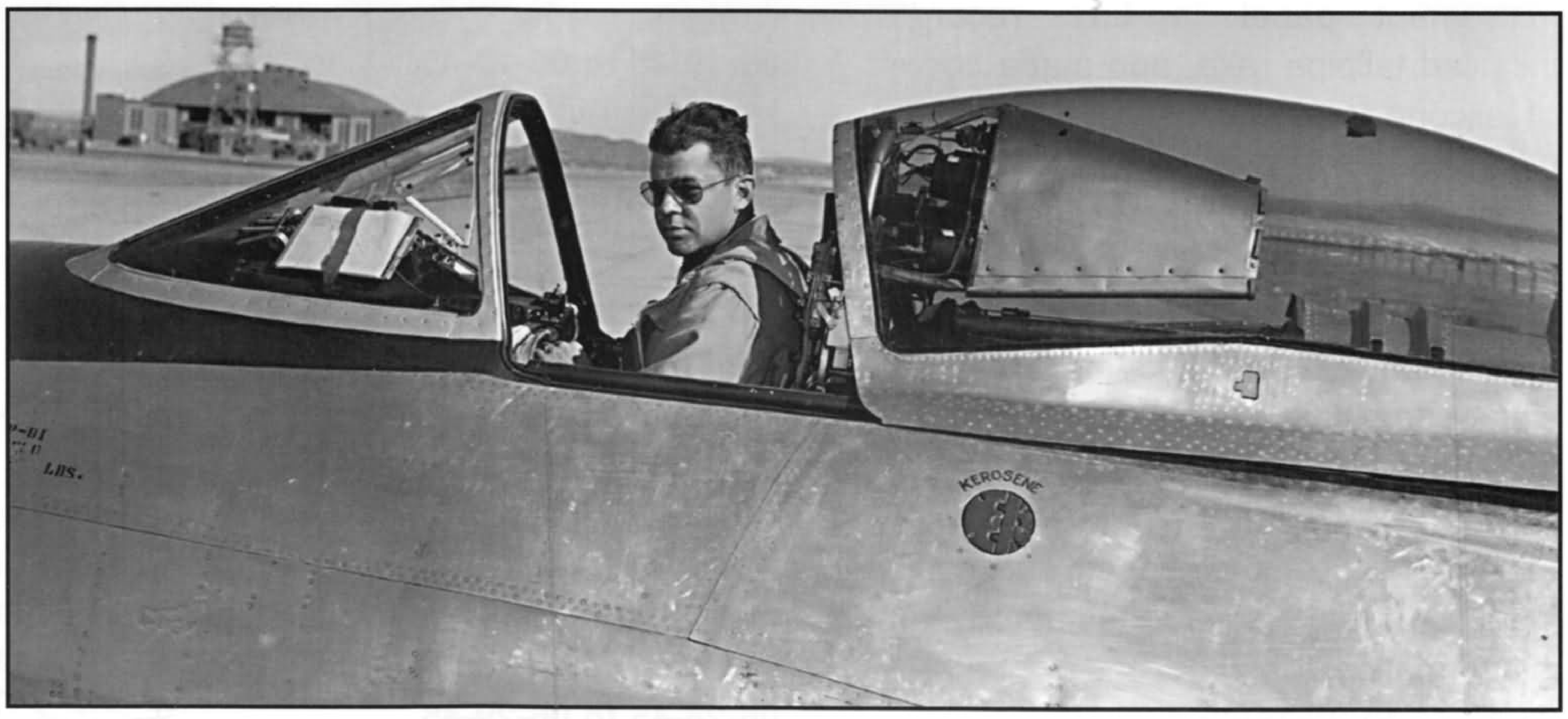
04-04-45 to 04-07-45
Flight 26-29 explored general flight characteristics and stalls.

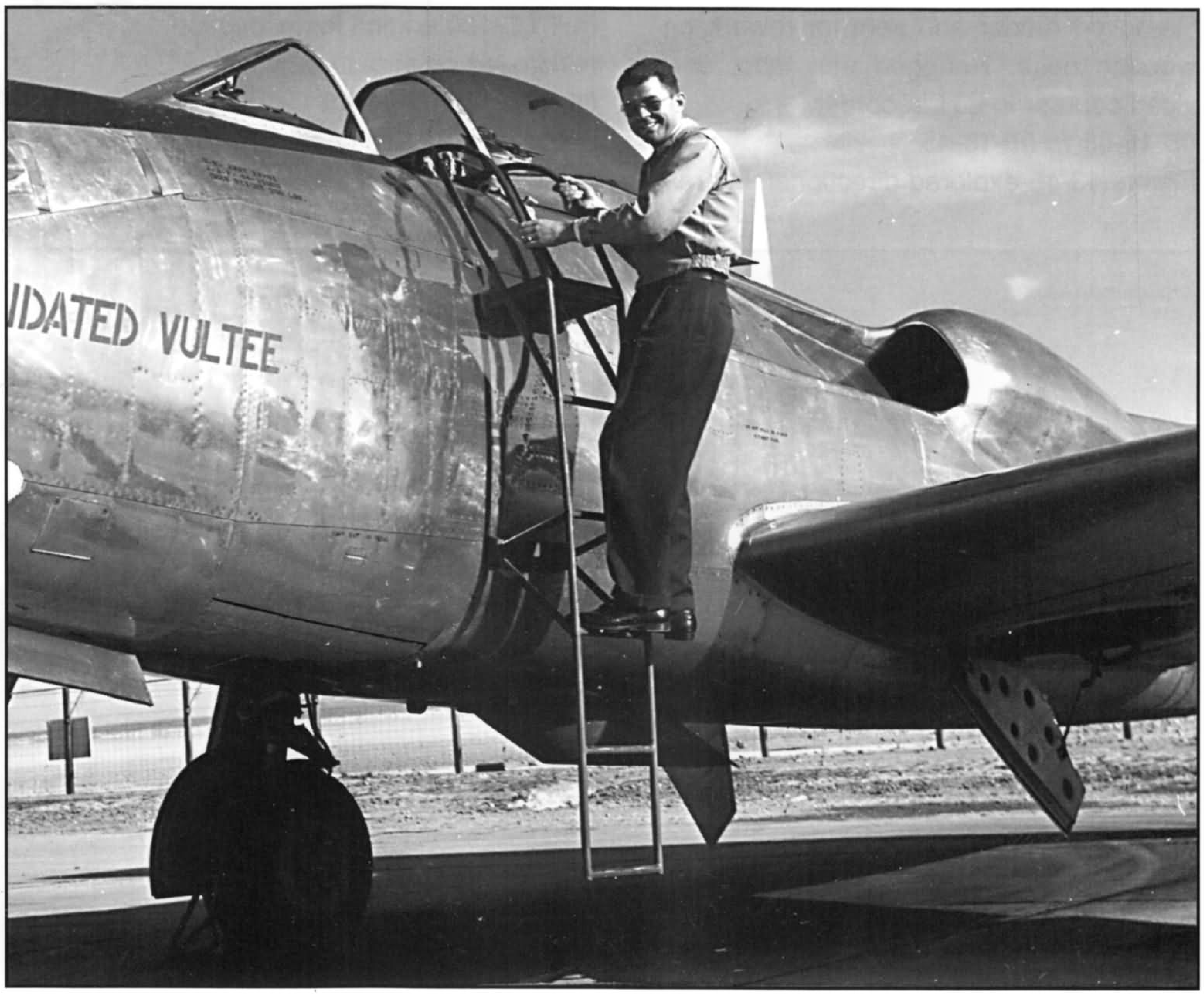
04-08-45 to 04-17-45
I-40 checked for damage that might have occurred during start. Replaced wind shield, reworked tail surfaces and dorsal fin. Re-located pressure pickups in left hand wheel well.

04-18-45 to 04-21-45
Flights 30-32 explored landing gear operation and general flight characteristics.

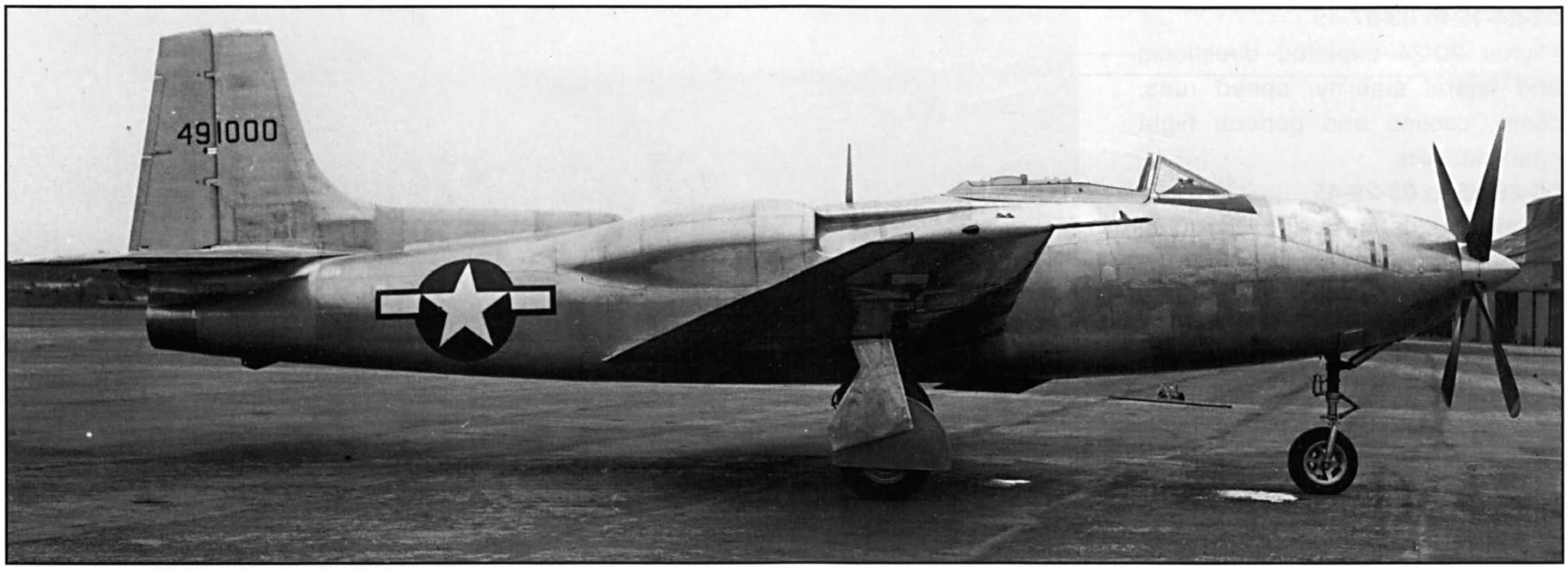
04-22-45 to 04-25-45
Changed instruments, removed tailcone to locate elevator boost tab position transmitter, sealed all main gear fairing doors and installed wing boxes.

04-26-45 to 04-27-45
Flights 33-35 explored landing gear operations, longitudinal and lateral control, and stalls.





At top right, Consolidated Vultee flight test crew pose with the XP-81. (Convair) Above right, Frank Davis in the XP-81's cockpit. The aircraft was built with a tinted canopy as seen here. (Convair) At right, Davis on the XP-81's boarding ladder. Note how far the TG-100 exhaust (behind ladder) protrudes from the belly. The outboard main landing gear doors have eight round holes on the inside surface. (Convair)



04-28-45 to 04-31-45
Removed I-40 for inspection, changed instrument panel in L.H. recorder, installed tailpipe rake, and made section of tailcone removable.

05-01-45
Flight 36 conducted heavy performance, speed, and climb tests.

05-02-45 to 05-03-45
Fabricated and installed forward extension of dorsal fin and changed instrumentation.

05-04-45 to 05-11-45
Flights 37-42 explored speed, cooling, the induction system, lateral and aerodynamic information.

05-12-45 to 05-14-45
Removed rudder and sent for rework on wooden nose. Rerigged trim tabs, serviced counter in L.H. recorder.

05-15-45 to 05-18-45
Flights 43-46 explored directional, lateral, and longitudinal flight characteristics, landing gear operations and airspeed calibration.

05-19-45 to 06-10-45
Merlin engine removed from airplane. Changes in airplane structure and instrumentation made to accommodate TG-100.

06-11-45 to 06-22-45
TG-100 engine received, inspected, and installed on the XP-81 for general operational checks.

06-23-45 to 06-27-45
General starting, operation, vibration and cooling checks with and without propeller installed. One short taxi run.

06-28-45 to 06-29-45
Pull TG-100 engine for inspection. Engine reinstalled on airplane.

06-30-45 to 07-01-45
Propeller vibration checks by Wright Field personnel.

07-02-45 to 07-04-45
TG-100 pulled for inspection then installed on tilting test stand.

07-05-45 to 07-06-45
Oil scavenging tests on tilting test stand.

07-07-06 to 07-26-45
TG-100 engine disassembled for G.E. design modifications including installation of a new compressor rotor, oil scavenge

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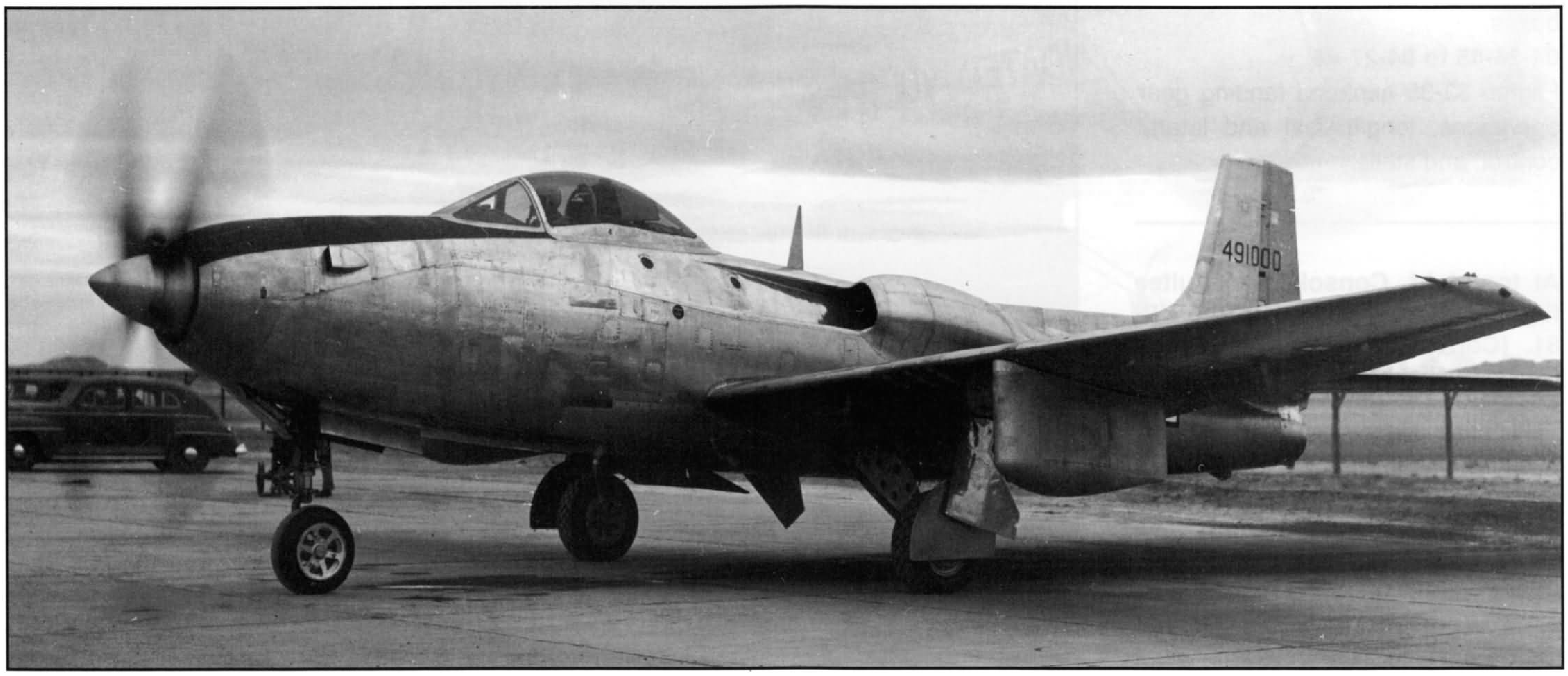
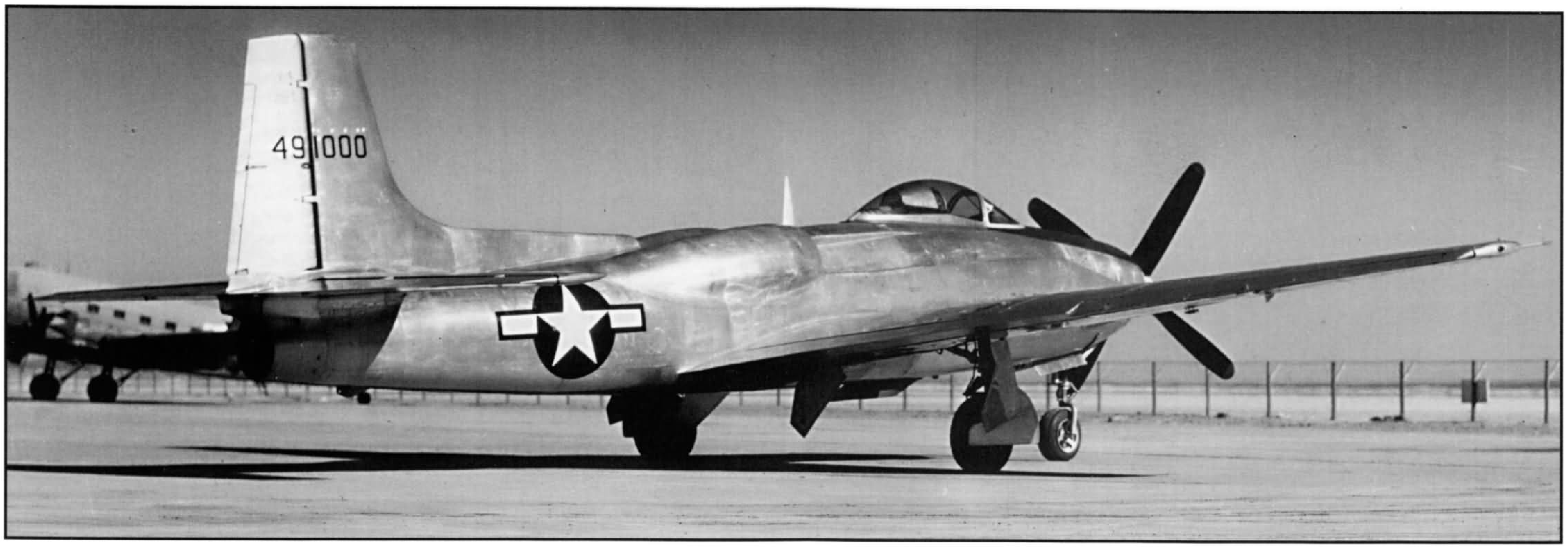
Above, XP-81 44-91000 shortly after installation of TG-100 engine. A new anti-glare panel has yet to be painted on the new engine cowls. The vertical fin and rudder were shortened on 5-12-45 in preparation of recipt of the TG-100. (Convair) Below, XP-81 44-91000 with TG-100 engine and slipper tanks installed runs up prior to an early taxi test. Note small air scoop on engine cowl below anti-glare panel. (Convair)





pump, and revised main bearing lubricating system.

07-27-45 to 08-01-45

TG-100 engine installed on tilting test stand for a study of oil system characteristics with regard to scavenging, consumption, leakage, venting, etc.

08-02-45 to 08-08-45

TG-100 engine removed from test stand and installed in airplane with Aeroproducts propeller.

08-09-45 to 08-22-45

Ground tests to establish an oil cooling configuration satisfactory for taxi and take off. Failure of turbine wheel with cast buckets occurred at the end of this period.

08-23-45 to 09-24-45

Inspection and overhaul period for the TG-100 engine. Modifications and instrumentation changes made and engine was re-installed in the airplane.

09-25-45 to 10-18-45

Preliminary ATSC acceptance tests run on TG-100 engine.

10-19-45 to 11-20-45

TG-100 removed and disassembled for ATSC acceptance inspection. Aircraft transported to AAF Flight Test, Muroc Field, CA. October 30th, reassembly of TG-100 delayed due to lack of equipment to rebuild compressor assembly. TG-100 engine transported to Muroc and installed in XP-81.

11-21-45 to 11-26-45

Operational check and engine cooling check.

11-27-45 to 12-11-45

Main inspection of TG-100 for ATSC acceptance.

12-12-45 to 12-20-45

Final ATSC acceptance test runs, emergency fuel system check and initial taxi test.

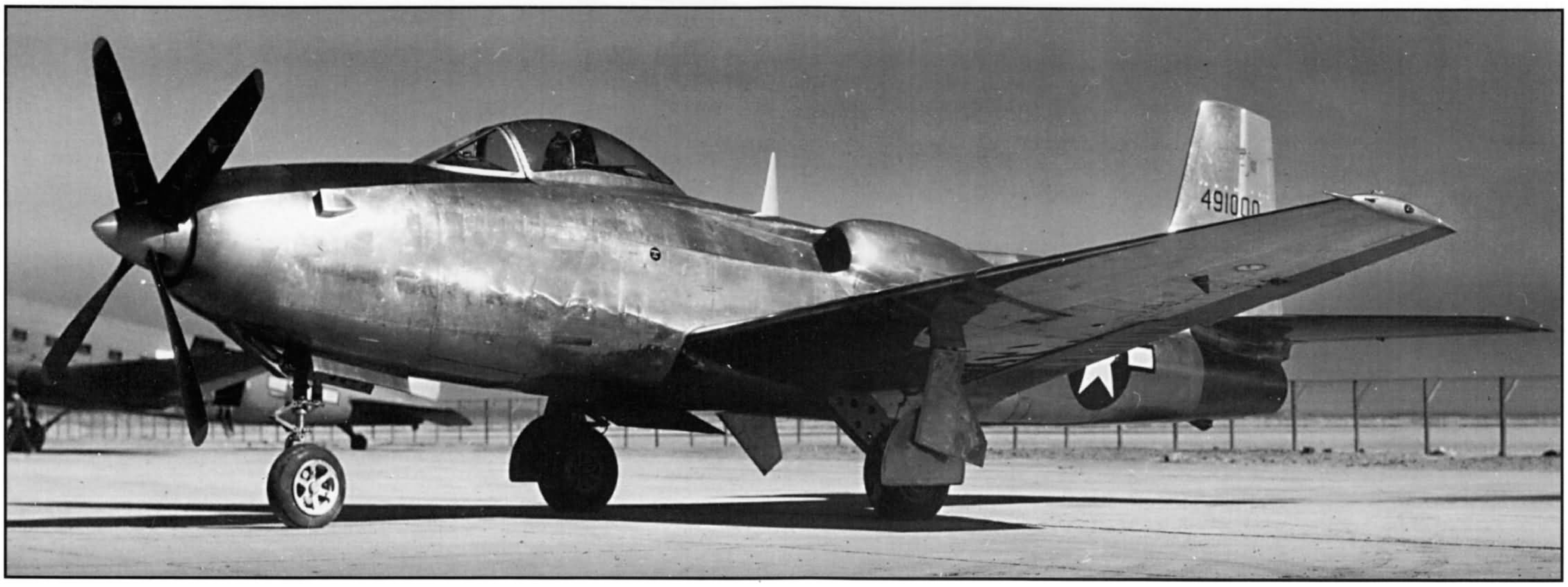
12-21-45

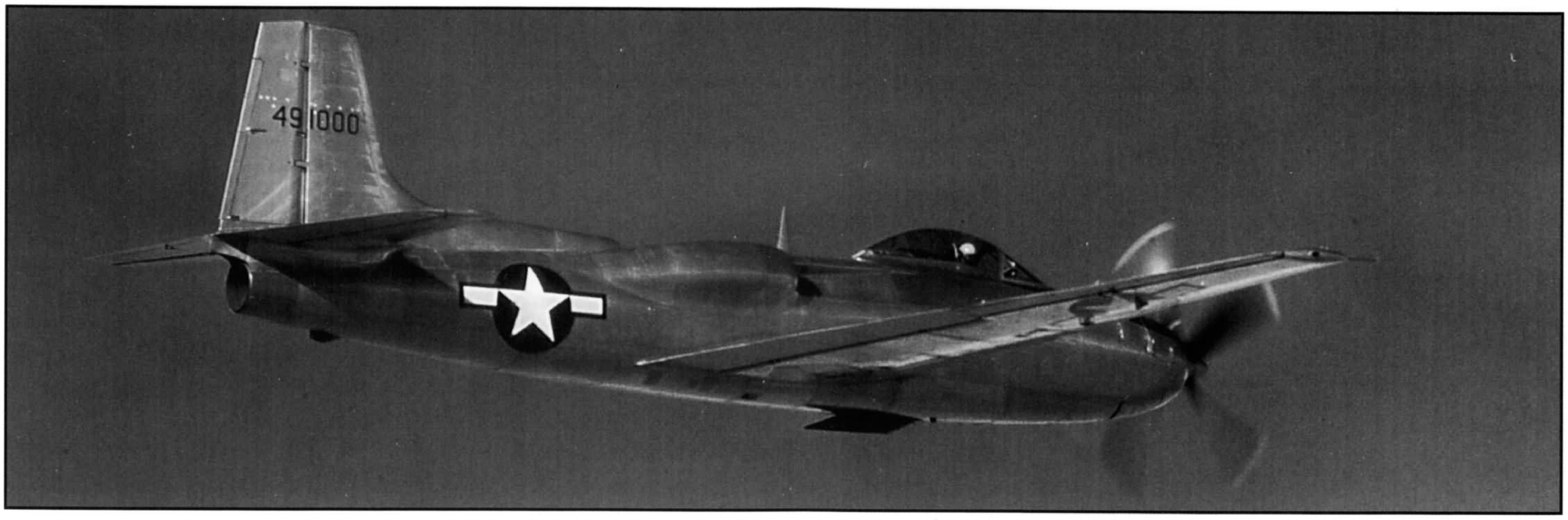
First flight with TG-100 engine (flight #47). For the flight, a 19" exhaust nozzle was fitted to the I-40 engine, the horizontal tail was moved aft 15-inches, trim and spring boost tabs were increased by 38%, decreased height of the vertical stabilizer and rudder by 10-inches, and the turning vane was installed at 5° T.E. right. The flight lasted 5-minutes and was deemed satisfactory, however excessive oil consumption was noted.

12-22-45 to 01-03-46

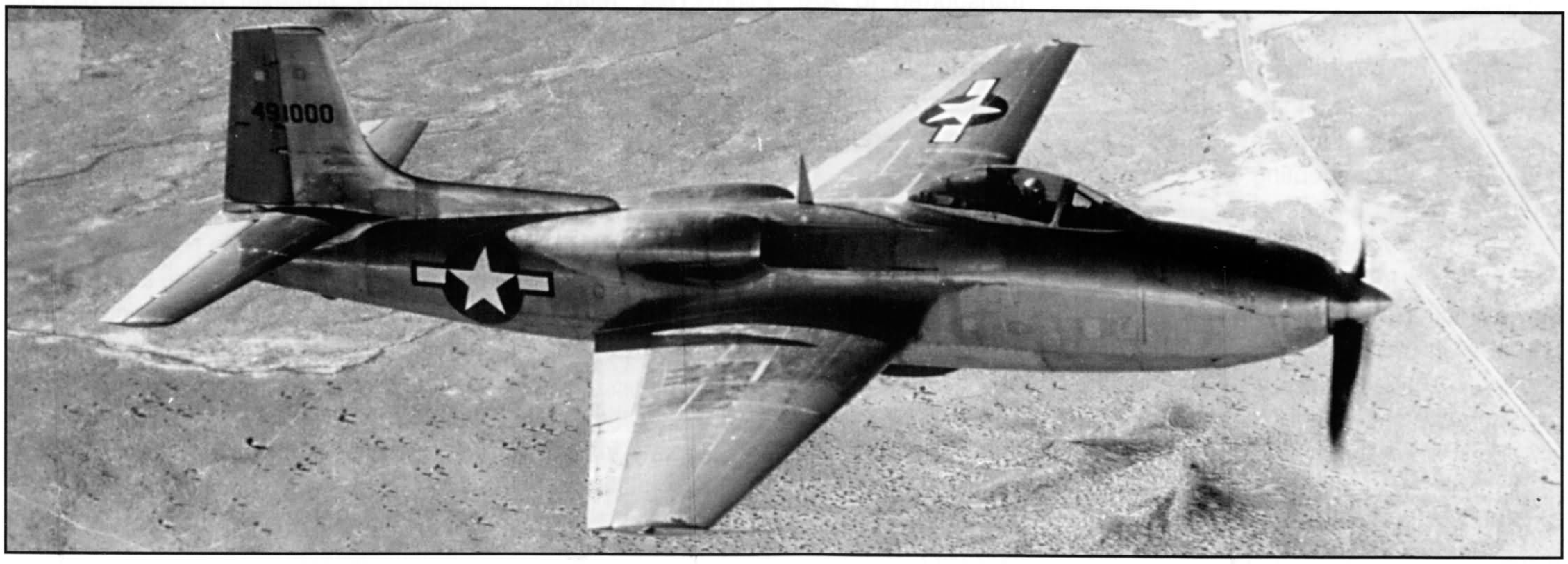
TG-100 removed from XP-81 to check for oil leaks. All fittings and hose clamps were tightened and gaskets were inspected. The Cuno oil filter screen gasket and drain plug "O" ring were replaced. The oil pump regulator base was found to be warped. It was straightened and replaced with a new gasket of greater thickness. During this period, the Cross Tube Fire Detector was repaired to eliminate false fire warnings due to short circuits. A new dual system was installed, using ribbon wire with two layers of glass weave plus a fiberglass sleeve.

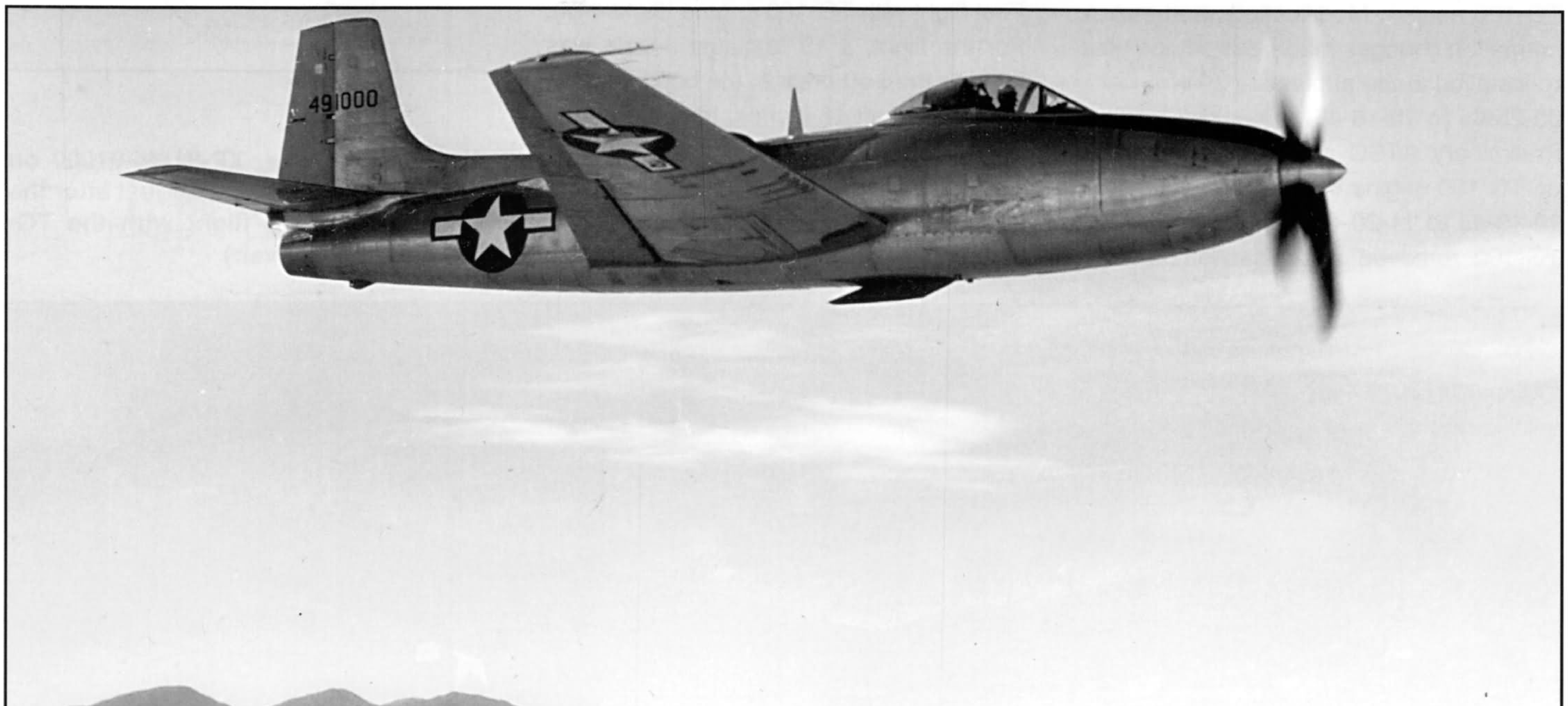
Above and below, XP-81 44-91000 on 1-18-46 either just prior or just after the aircraft's seventh flight with the TG-100 engine. (Convair)

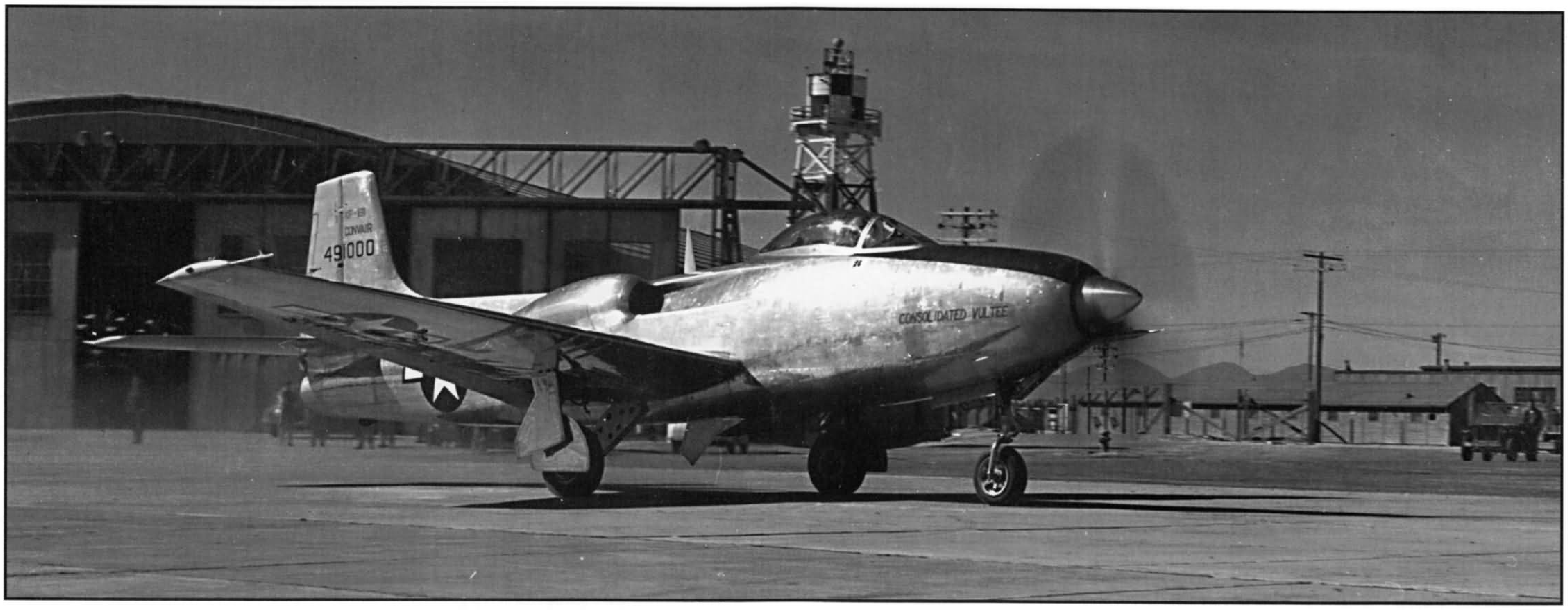




Above and below, XP-81 44-91000 in flight on 18 January 1946 during flight 53, one of five made for public relations and photographic purposes. Note extent the TG-100 exhaust pipe protrudes from the belly. (Convair)







Above, XP-81 44-91000 taxis-out for a photo flight on 22 January 1946 (SDAM) Below, the big fighter over the Mojave Desert during the photo flight on 22 January 1946. (Convair)

01-04-46 to 01-09-46

Flights 48-50. Normal and emergency fuel system checks. Engine and propeller vibration and cooling tested in climb to 10,000 feet. During flight #48, the I-40 tail cone became loose during flight, 4 of 14 invar strut nuts (tie straps) had become loose. Following flight #48, the propeller low pitch stop was set at 15°.

01-10-46 to 01-15-46

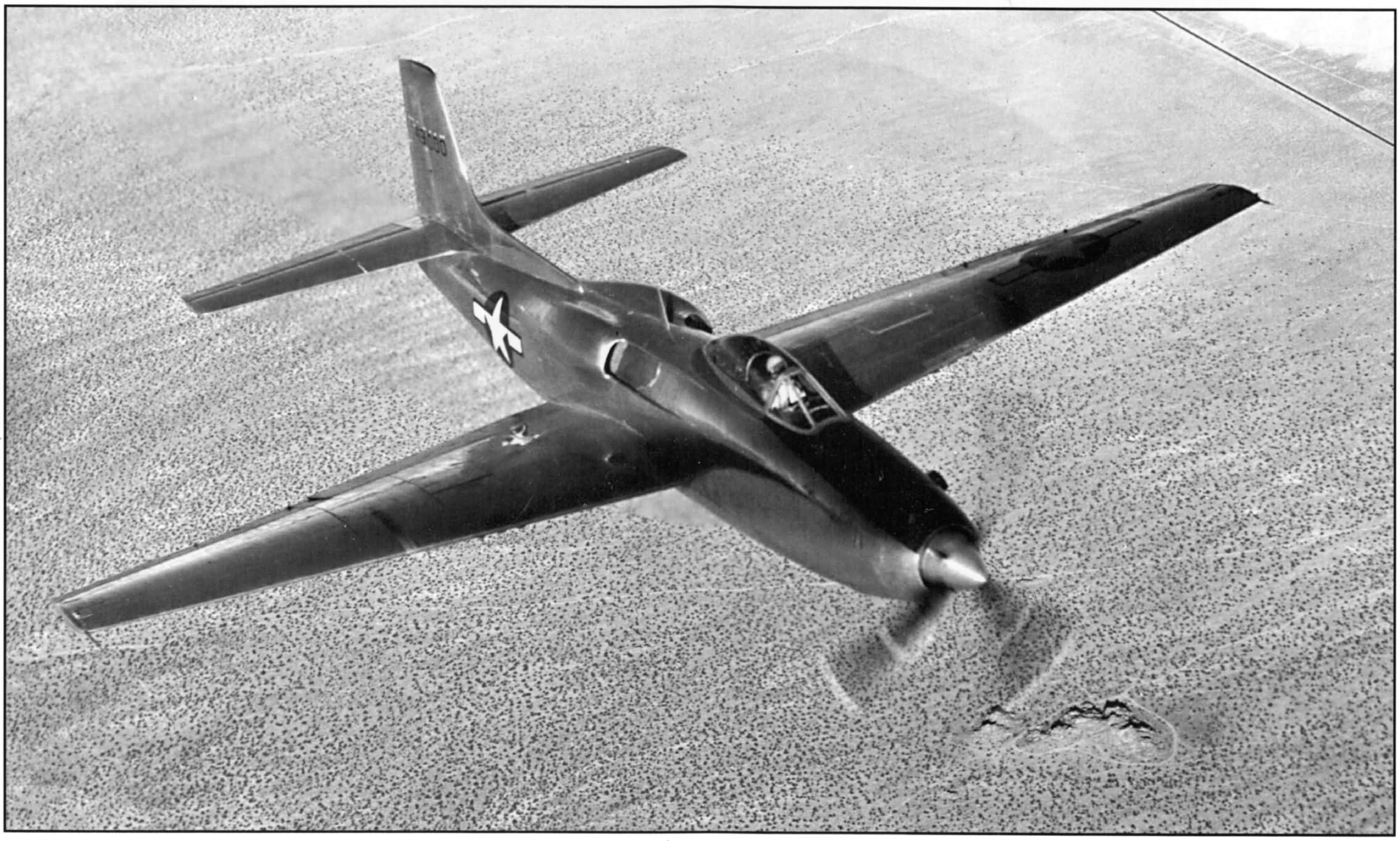
TG-100 ten hour inspection performed. The stainless steel heat shield was removed from the bottom of the airplane.

01-16-46 to 02-04-46

Flights 51-60. Five flights were made for demonstration, publicity, and photography. Powerplant cooling and propeller vibration were also explored as was one performance flight and prop feathered in flight. Following flight 57, it was discovered that the generator cooling air duct was not lined up, the discrepancy was corrected. For flight 59, the TG-100 vibration problem was somewhat corrected by adding weights to the propeller to correct aerodynamic or dynamic unbalance. During flight 60 it was discovered that insufficient throttle travel existed. An additional 7/8” travel was added to correct the problem.

02-05-46 to 03-04-46

TG-100 was removed for 10 hour inspection. The oil cooler installation was



revised and the external scoop was removed. The I-40 engine was also removed for inspection and the I-40 air intake ducts were revised.

03-05-46 to 03-08-46

Flights 61-62 tested engine cooling during maximum power climb, level flight and shut down. During these flights, the thermal units started to cut out, causing a sudden drop in fuel pressure with subsequent loss in engine power.

03-09-46 to 03-13-46

I-40 routine inspection including turbine wheel clearance check. The fuel pressure problem experienced in flights 61 and 62 was fixed by installing new quartz rods in the thermal units. The elevator boost tab contour was also changed.

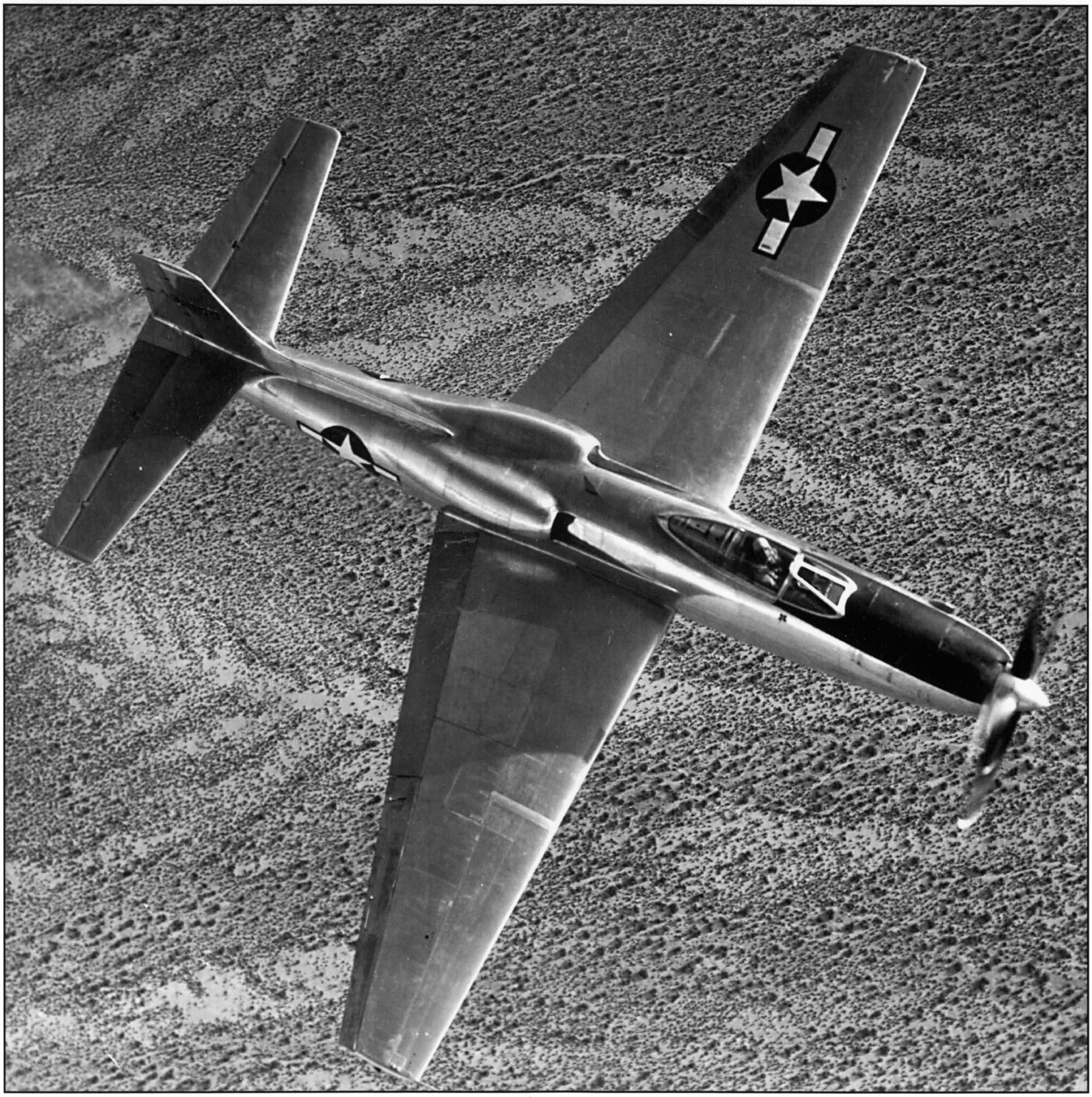
03-14-46 to 03-19-46

Flights 63-67 included directional characteristics and flight performance at 10,000 feet and two pilot familiarization flights for Sam Shannon.

03-20-46 to 04-17-46

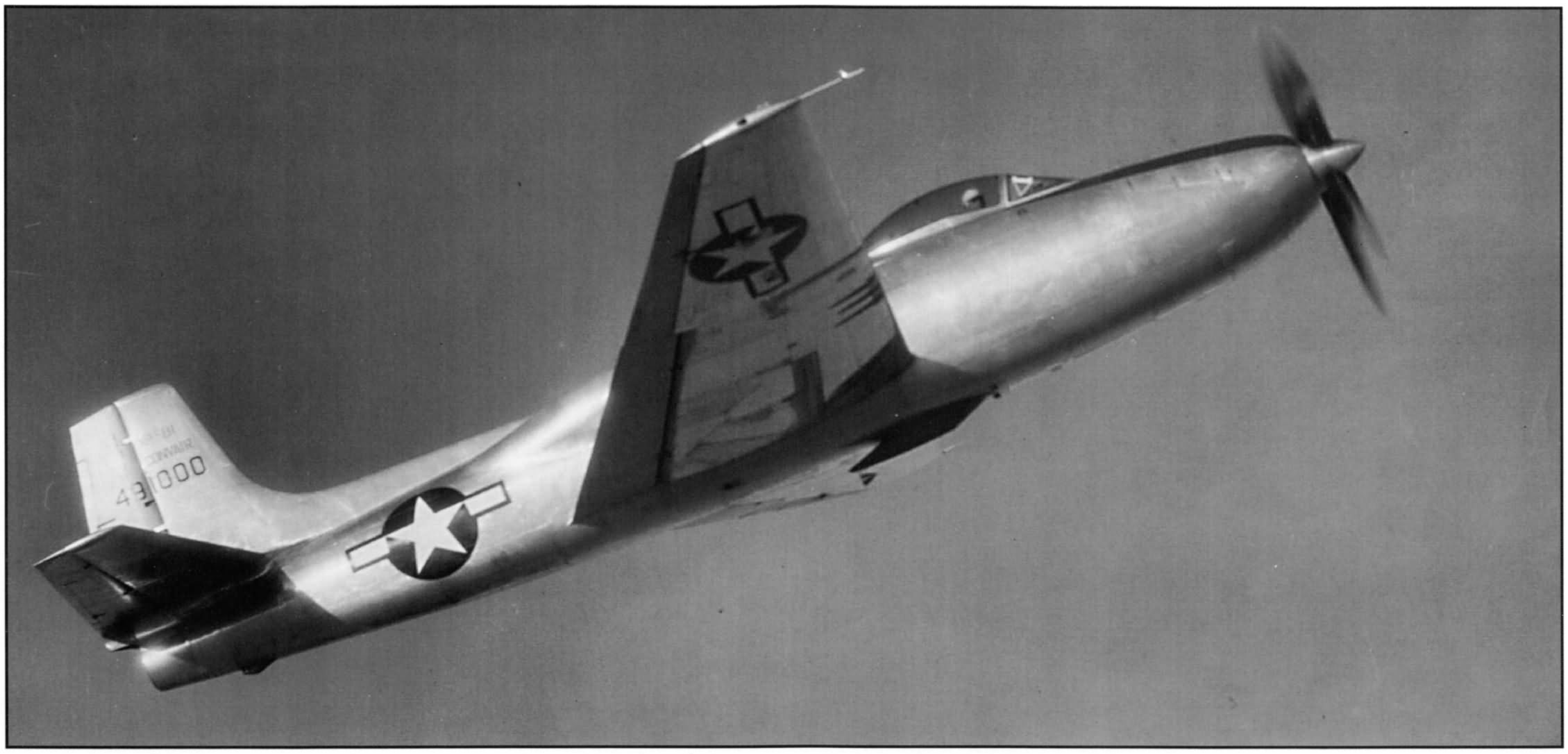
TG-100 10-hour inspection performed. Vertical stabilizer and rudder extended 10.96 inches. 6-inches were added to the ventral fin and I-40 boundry layer removal ducts were installed. The I-40 tailpipe was revised to provide a jet pump and the I-40 tailpipe shroud was removed. The oil cooler exit fan was also removed. New master brake cylinders designed espe-

Below, overhead view illustrates large straight wing leading edge, swept forward trailing edge, large horizontal stabilizer and distinctive I-40 upper fuselage intakes. (Convair)



CONSOLIDATED VULTEE

XP-81
CONVAIR
491000
CONSOLIDATED VULTEE

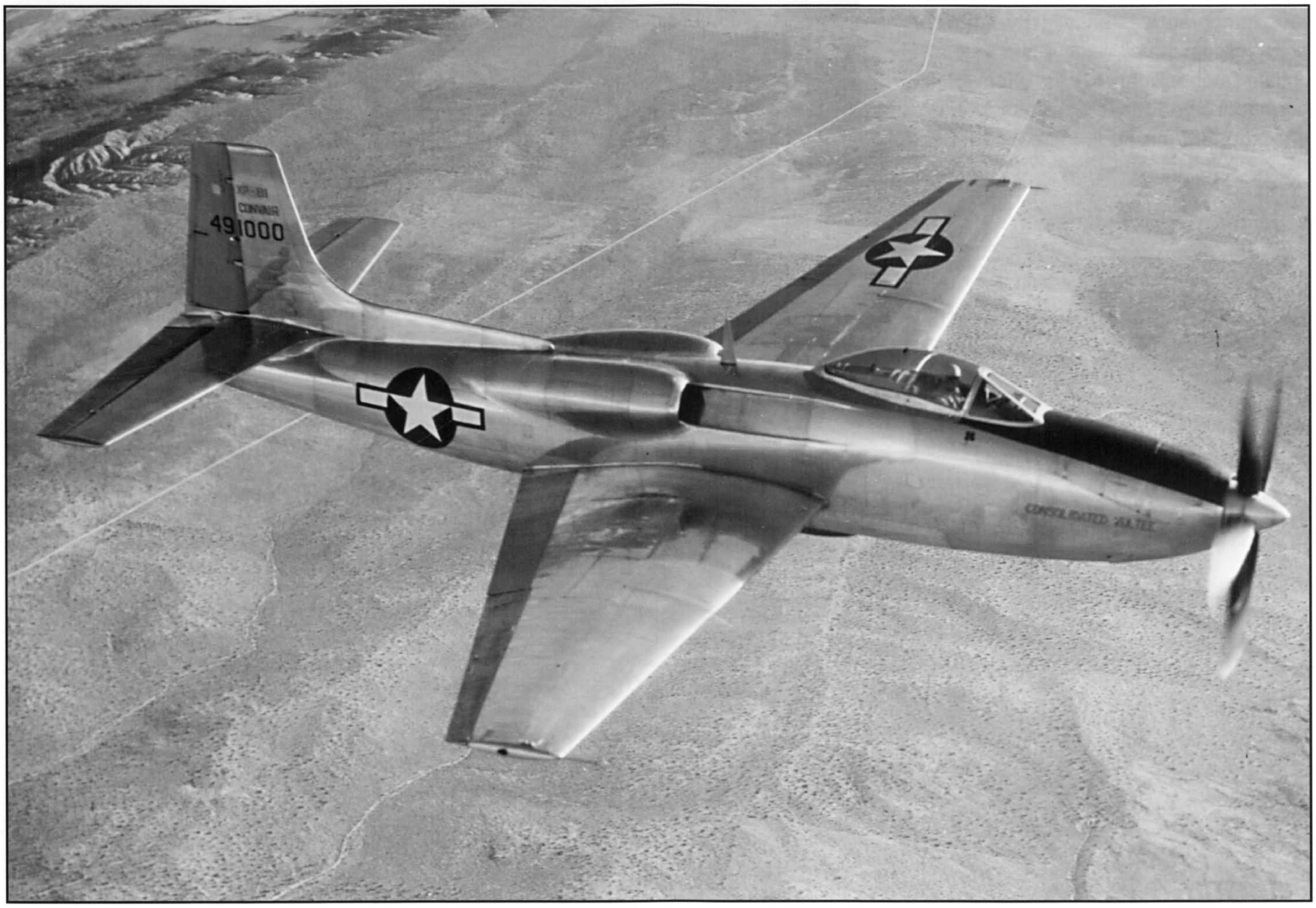


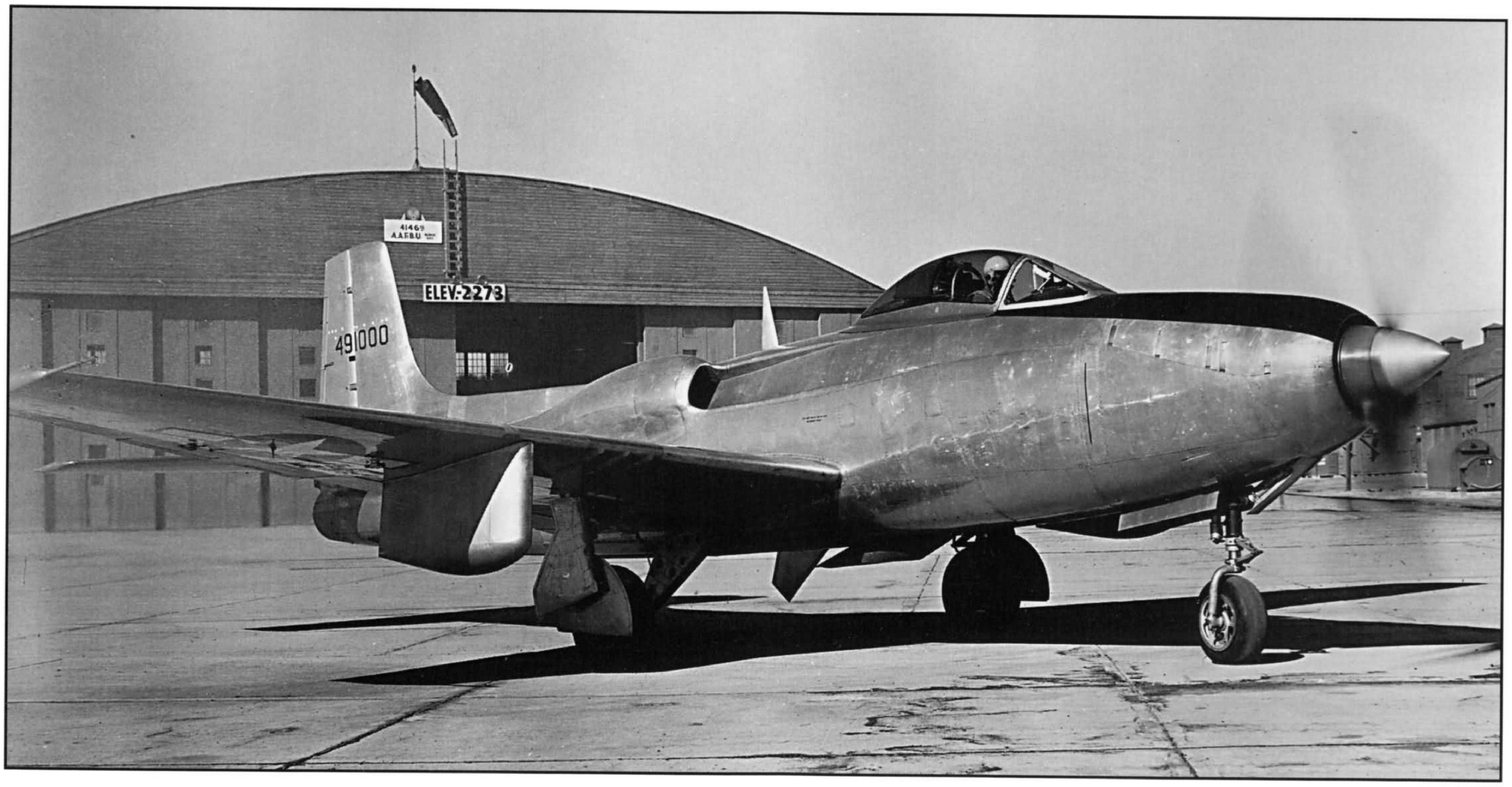
cially for this airplane were installed to replace the Gladden cylinders. Improved landing gear door actuators were installed to increase door operational airspeeds to 180 mph.

04-18-46 to 05-07-46

Flights 68-77 explored directional stability and control with maximum forward and rear C.G. locations. Also single engine climb with each engine was tested.

Four views of XP-81 44-91000 in flight on 25 January 1946 while on a familiarization flight for Sam Shannon. Note the four-leaf clover under the canopy rail which was Shannon's trademark. (Convair)



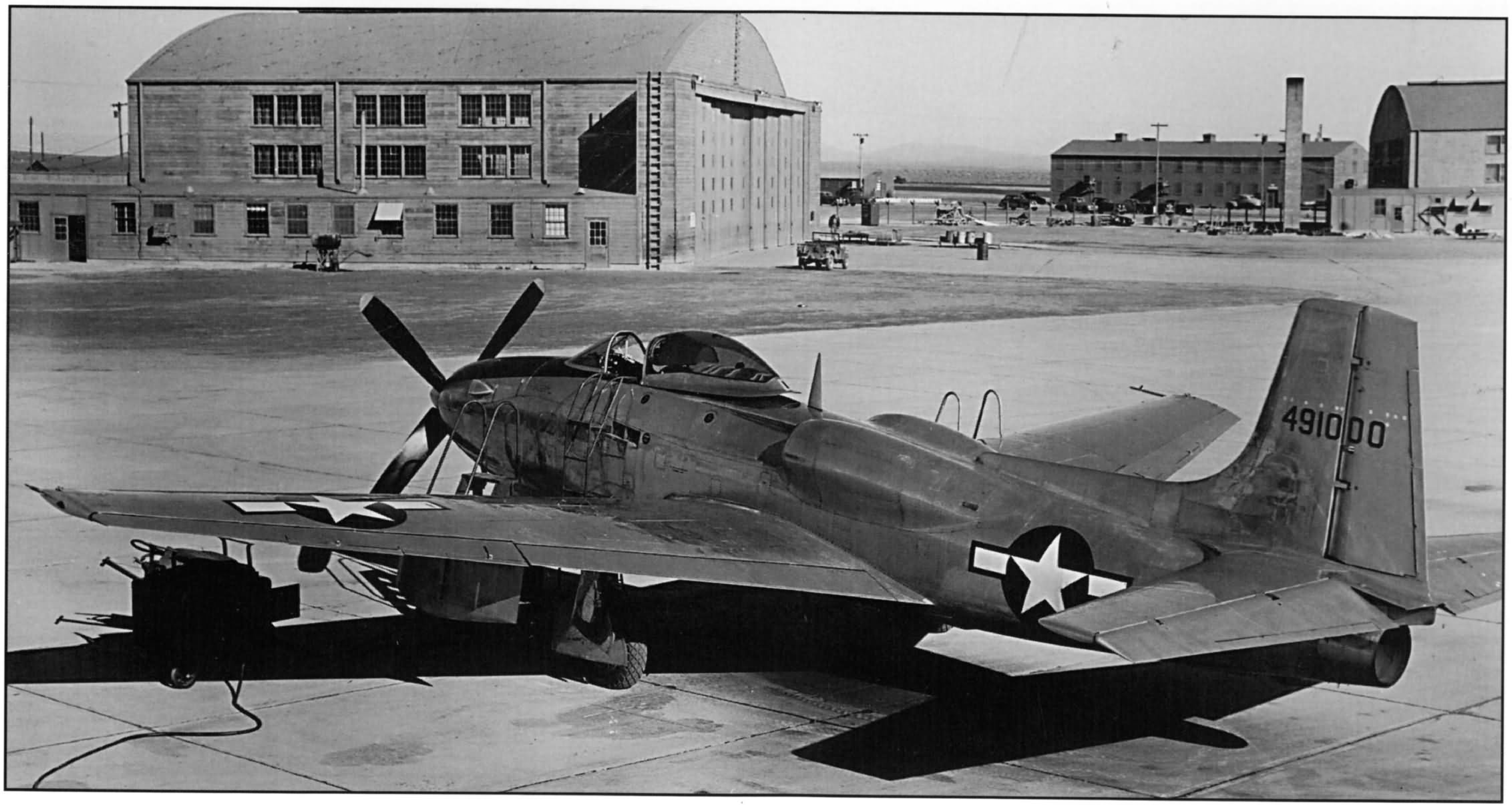


Above and below, XP-81 SerNo 44-9100 prepares for a test flight with its unique wing-mounted slipper/ferry tanks installed. (Otto Menge via Mike Herrill and Wayne Morris)

Propeller feathering, engine windmilling and inflight starting characteristics were also explored. For flight 70, the two auxiliary cooling air ducts to the TG-100 tail pipe shroud were blocked off. The structure temperatures ran slightly higher in some cases, but all were within allowable limits. During flight 76 the effect of the boundary layer duct on performance was checked, and an 80 lb increase in thrust was realized.

05-08-46 to 07-10-46
TG-100 and I-40 50-hour inspection and overhaul accomplished by AAF personnel. Replaced TG-100 turbine wheel and modified the #5 bearing assembly. Fire doors were installed in the fuselage section of the airplane. The TG-100 tailpipe thermocouple wires were replaced.

07-11-46
Flight 78 was a maximum performance climb to 30,000 feet and level flight performance at 30,000 feet. Followed by a descent at .75 Mach. An unsteady dutch roll instability of a small magnitude,



accompanied by buffeting, occurred in high speed level flight at 30,000 feet.

07-12-46 to 07-18-46

Removed Aeroproducts propeller and installed Hamilton Standard propeller. Wing gun doors were added, and the nose wheel strut was replaced by borrowing the unit from the #2 aircraft. Mud shields were installed on both main landing gear inboard doors' operating quadrants.

07-19-46 to 08-08-46

Flights 79-89 explored directional stability and control, airspeed calibration, propeller vibration and I-40 windmilling. These flights were flown with a 10" extension to the vertical fin and rudder which eliminated directional hunting in high speed level flight at 30,000 feet. A ventral fin which provided space for anti-icing air ducts was tested with no adverse flight qualities. Two military power level flight speed runs were made at 30,000 feet during flights 85 and 89. One climb to 30,000 feet was made during flight 89, which showed about the same rate-of-climb with the Hamilton Standard as with the Aeroproducts propeller.

08-09-46 to 09-03-46

Cabin refrigeration and TG-100 10-hour inspection. Installed oil level warning switch, fuel tank vent screen, aileron preload device, new battery vent system, cockpit floor cooling blast tubes, reworked nose gear and replaced the TG-100 starter.

09-04-46

Flight 90 explored the Hamilton Standard propeller flight characteristics. During the flight a dive was made from 30,000 feet. At about 12,000 feet, 420 mph IAS, Mach .73, severe power fluctuations started. They were stopped by locking the propeller pitch. During this flight, the maximum performance of the XP-81 was achieved. These were:

MAX true speed	**546 mph**
MAX IAS	**436 mph**
MAX acceleration	**1.9G**
MAX Mach No.	**.745**

09-05-46 to 09-25-46

Removed TG-100 unit #5 and installed #10 unit because the turbine wheel in unit #5 was cracked beyond allowable limits (the wheel lasted only one flight). Installed TG-100 torque oil pressure bypass valve and TG-100 and I-40 throttle stops.

09-26-46 to 09-27-46

Two ground runs were made to study starting characteristics of the TG-100 and to induce power fluctuations encountered in flight.

09-28-46 to 12-8-46

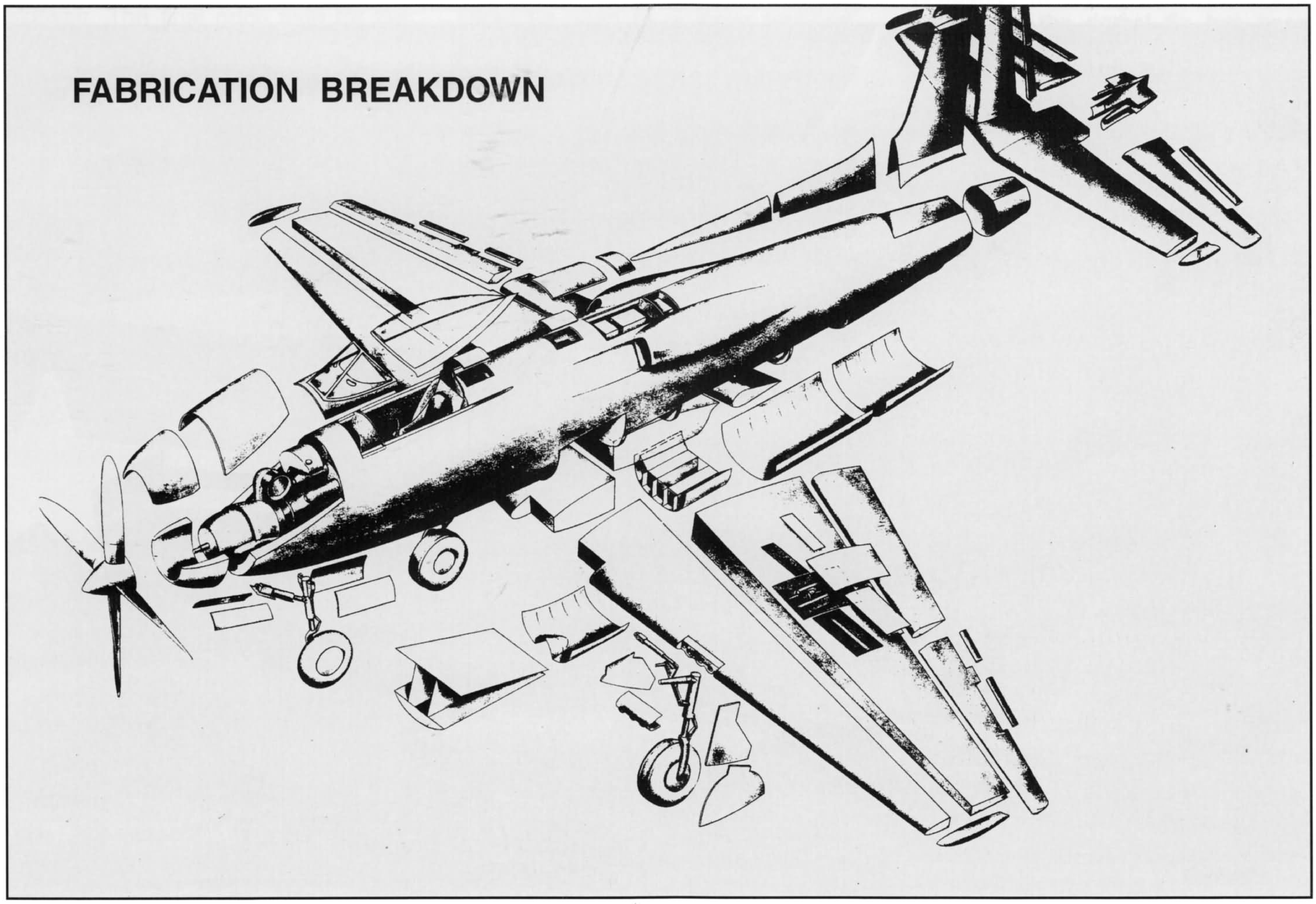
TG-100 engine removed for inspection. Turbine wheel condemned. Re-assembly of the TG-100 held up pending arrival of a new wheel. Satisfactory replacement arrived 11-25-46.

12-09-46 to 12-17-46

Flight 91-93 investigated power fluctuations due to propeller malfunction.

One more flight, number 94, was made in the first aircraft (SerNo 44-91000) between 12-17-46 and 1-24-47. A spare turbine wheel was received on 25 November 1946 and was installed in the second aircraft (SerNo 44-91001) in January 1947 in preparation for its first flight. According to Air Force records, a total of 116 XP-81 flights were completed,

FABRICATION BREAKDOWN



22 with the second aircraft equipped with the 12' diameter Hamilton Standard Superhydromatic propeller. On 14 January and on 3 February Convair published the proposed flight test program for 44-91001. For the tests the following equipment was removed: one of the two anti-icing scoops, the tail warning unit, and the automatic pilot actuating equipment. The 14 January test program called for five major areas to be explored:

1.) Lateral stability and control characteristics.
2.) Test armament equipment including .50 cal machine guns (6), 20mm cannons (6), bombing tests, and rocket firing tests.
3.) Anti-icing equipment.
4.) Cabin pressurization equipment.
5.) Power plant operation.

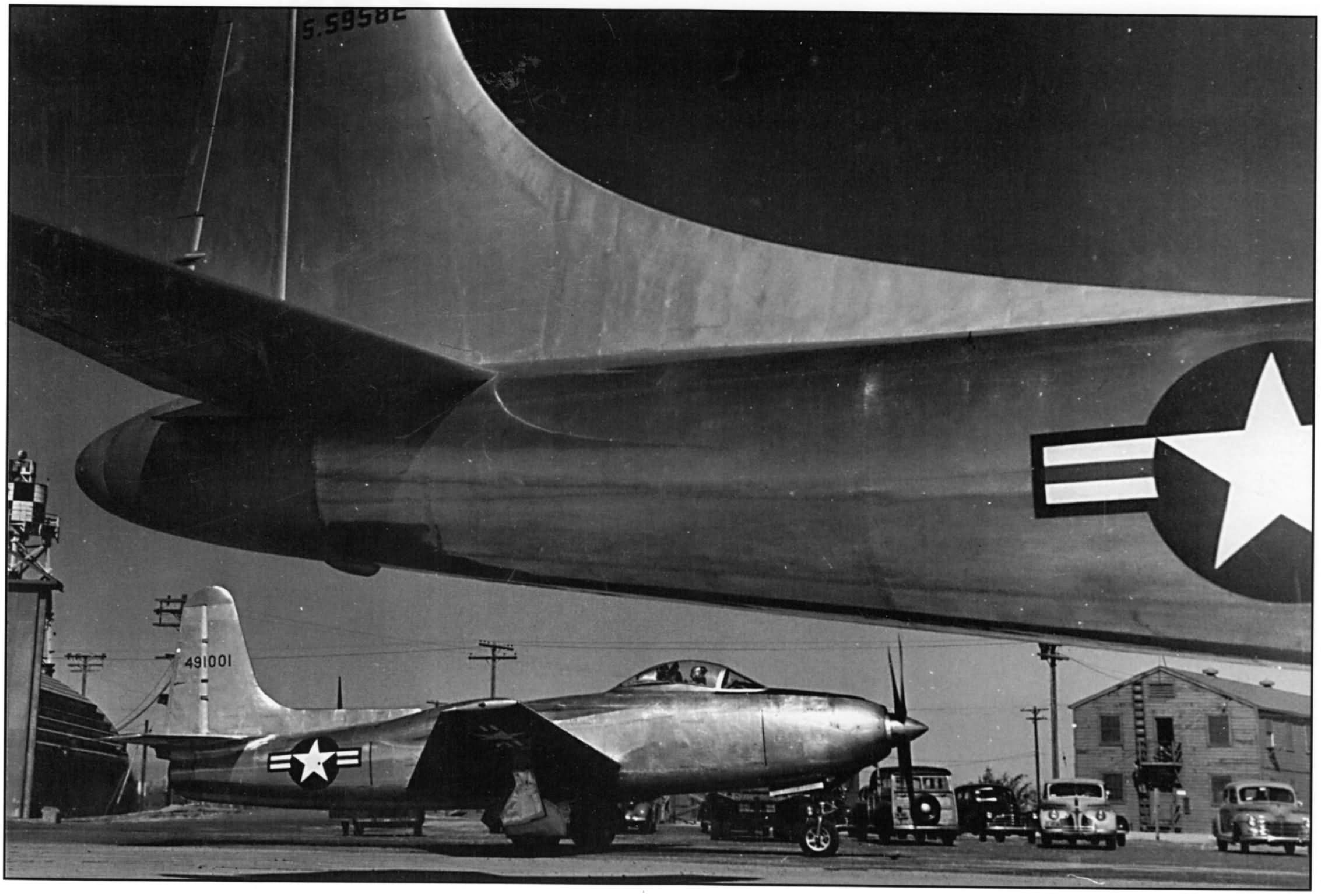
The exact date of the first flight of 44-91001 is unknown, but took place sometime in February 1947, as on 11 March 1947, Convair amended the flight test schedule by ordering "The purpose of the flight test program for the next few flights of the Model 102-2 is to improve the aileron control force characteristics and to determine the aileron control power." No other records were found documenting the test flights of 44-91001, but two photos exist showing the aircraft taxing out for a test flight in April 1947. It can only be assumed that flying continued up until project cancellation on 9 May 1947.

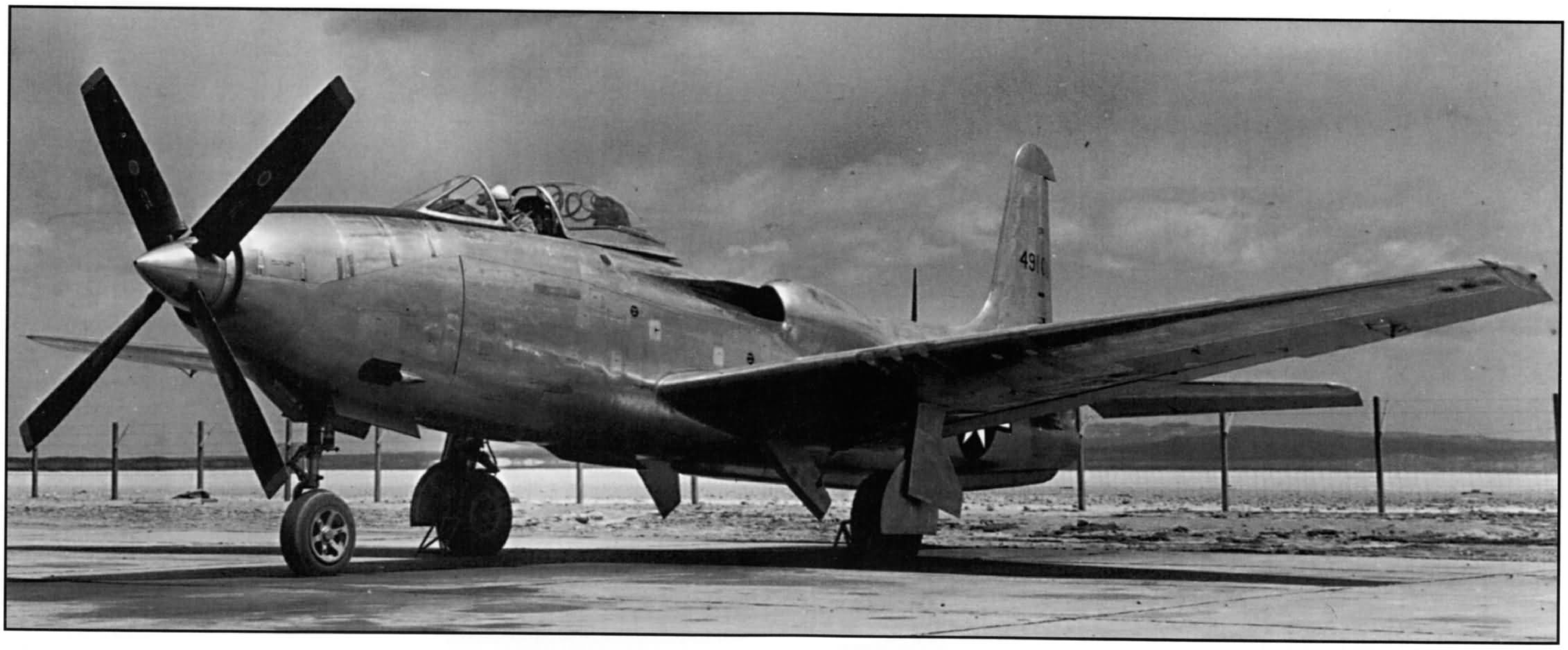
CONTRACT TERMINATION

On 31 December 1946, in an attempt to save the XP-81 program, Convair proposed to the Air Material Command a fix for the troublesome and underpowered TG-100. The proposal called for the TG-100 to be replaced with a G.E. TG-110 prop-jet engine in the nose and a J33-19 turbojet engine in the tail. The TG-110 was projected to produce 2,720 shaft horsepower at sea level, 1,020 horsepower improvement over the TG-100B engine and the J33-19 (I-40) which offered a 250 lb improvement in thrust over the J33-17 engine. Installation of the TG-110 would require a redesign of the nose section forward of the firewall to support the increased size and weight, enlarging the tailpipe, modification of the nose gear actuator, and to move the wing forward 7-inches to maintain proper balance. These changes would increase the gross weight from 19,500 lbs to 21,188 lbs.

The Engineering Division of the Air Material Command did not act on the proposal and it stopped all development work on the TG-100 in early 1947. On 27 January 1947, the con-

Below, the second XP-81 44-91001 with extended vertical tail and small ventral fin taxis-out for a test flight from Muroc's North Base in April 1947. Aircraft passes behind the tail of the super-sleek Convair XB-46 jet bomber also being tested at that time. (AFFTCHO)

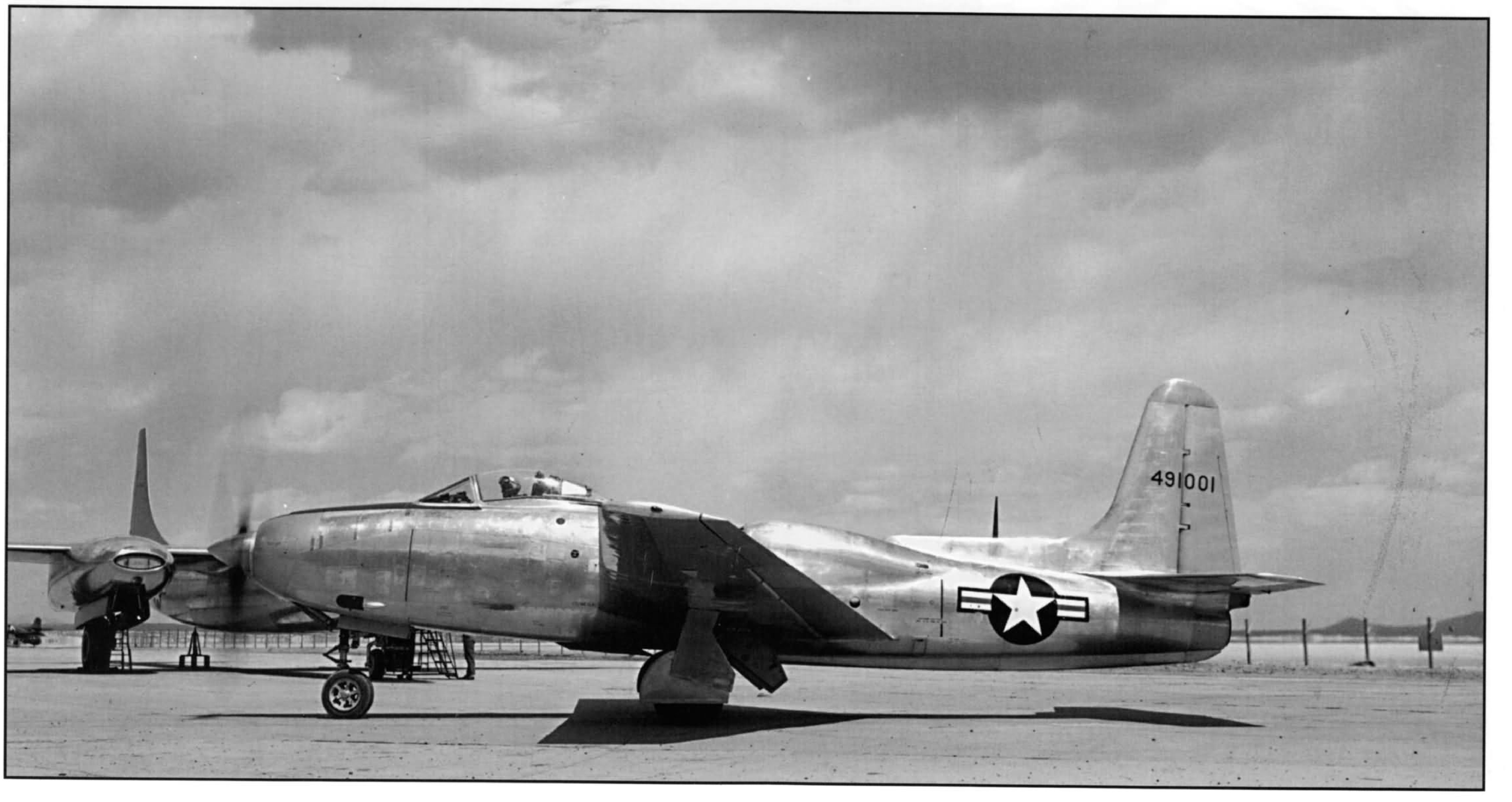


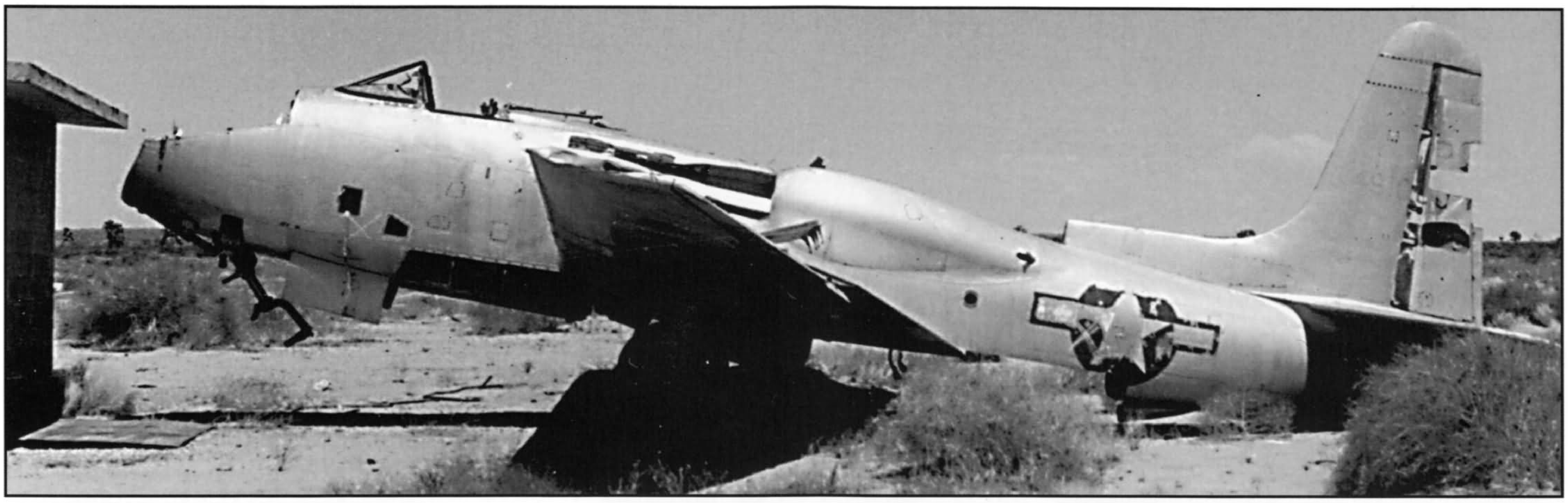


tract for thirteen production aircraft was cancelled. Then on 9 May 1947, the government terminated the XP-81 development contract. The two aircraft (44-91000 and 44-91001) were accepted by the Air Corps on 24 and 25 June 1947 respectively. In July 1947, the Air Corps became the United States Air Force and on 23 June 1948, they settled-up with Convair. The final price paid for the XP-81 program was $4,578,231.37. $159,902.69 was the adjusted fixed fee and $4,418,328.68 was for reimbursement of costs.

At the time of contract cancellation, both the Power Plant Laboratory and the Propeller Laboratory of the Air Material Command were engaged in developing propeller controls for use on future gas turbine engines. Since wind tunnels for testing the controls under all flight conditions were not available, the laboratories concerned suggested that the XP-81 might be used as a flying test-bed. Consequently the two aircraft were placed in storage at Edwards AFB (previously Muroc AAF). Funds were never allotted, and on 29 April 1949, reclamation and salvage was ordered on the XP-81s. After all useful parts

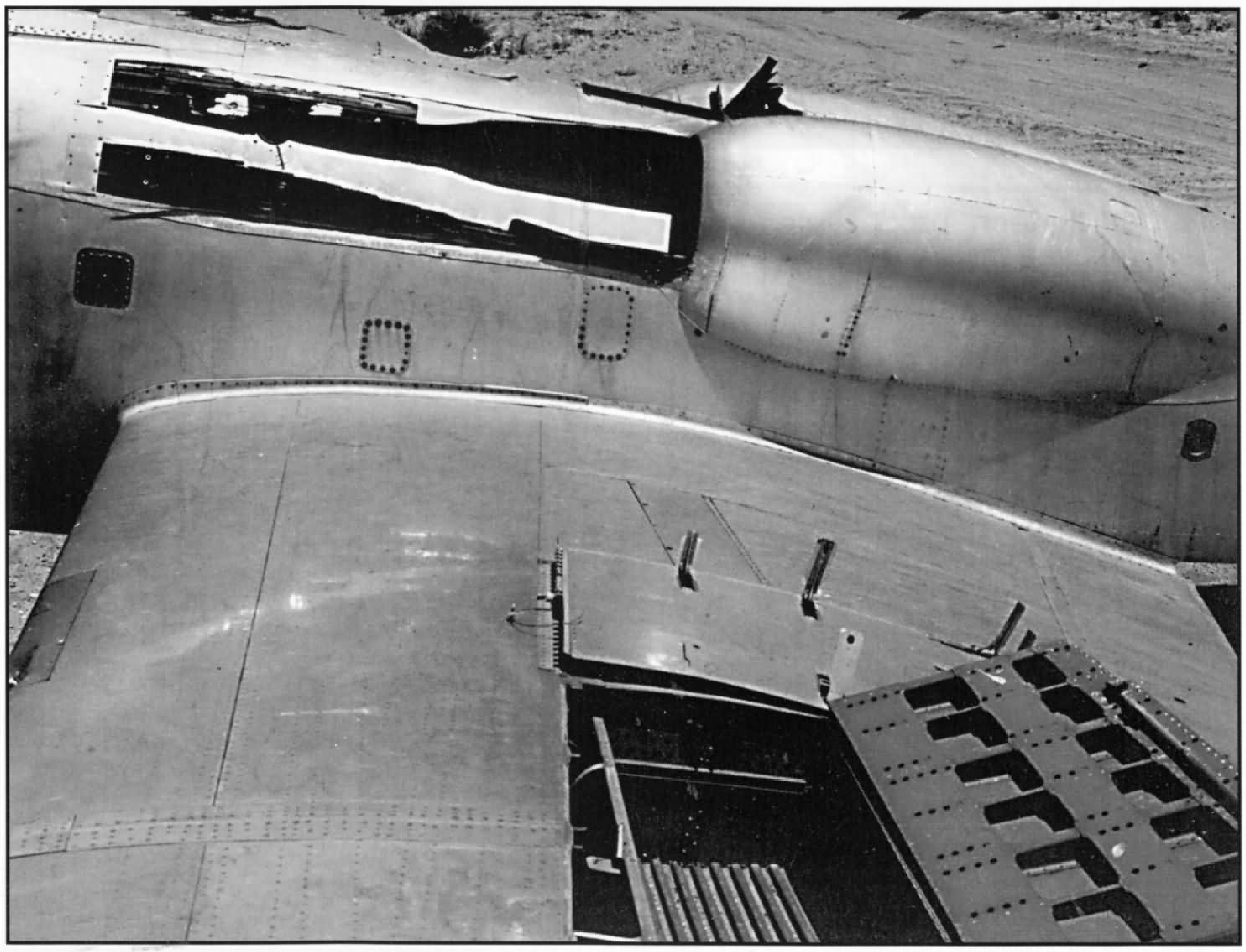
Above, 44-91001 was fitted with the 12' 6" diameter Hamilton Standard Superhydromatic propeller. The I-40 intakes have been reshaped to closer resemble NACA style intakes. An air scoop has been added to the lower TG-100 engine nacelle. (Convair) Bottom, 44-91001 with Reuben Snodgrass at the controls passes by Convair's XB-46 prior to a test flight in April 1947. In addition to the enlarged vertical fin and ventral fin, the dorsal fin has been enlarged too. (Convair)



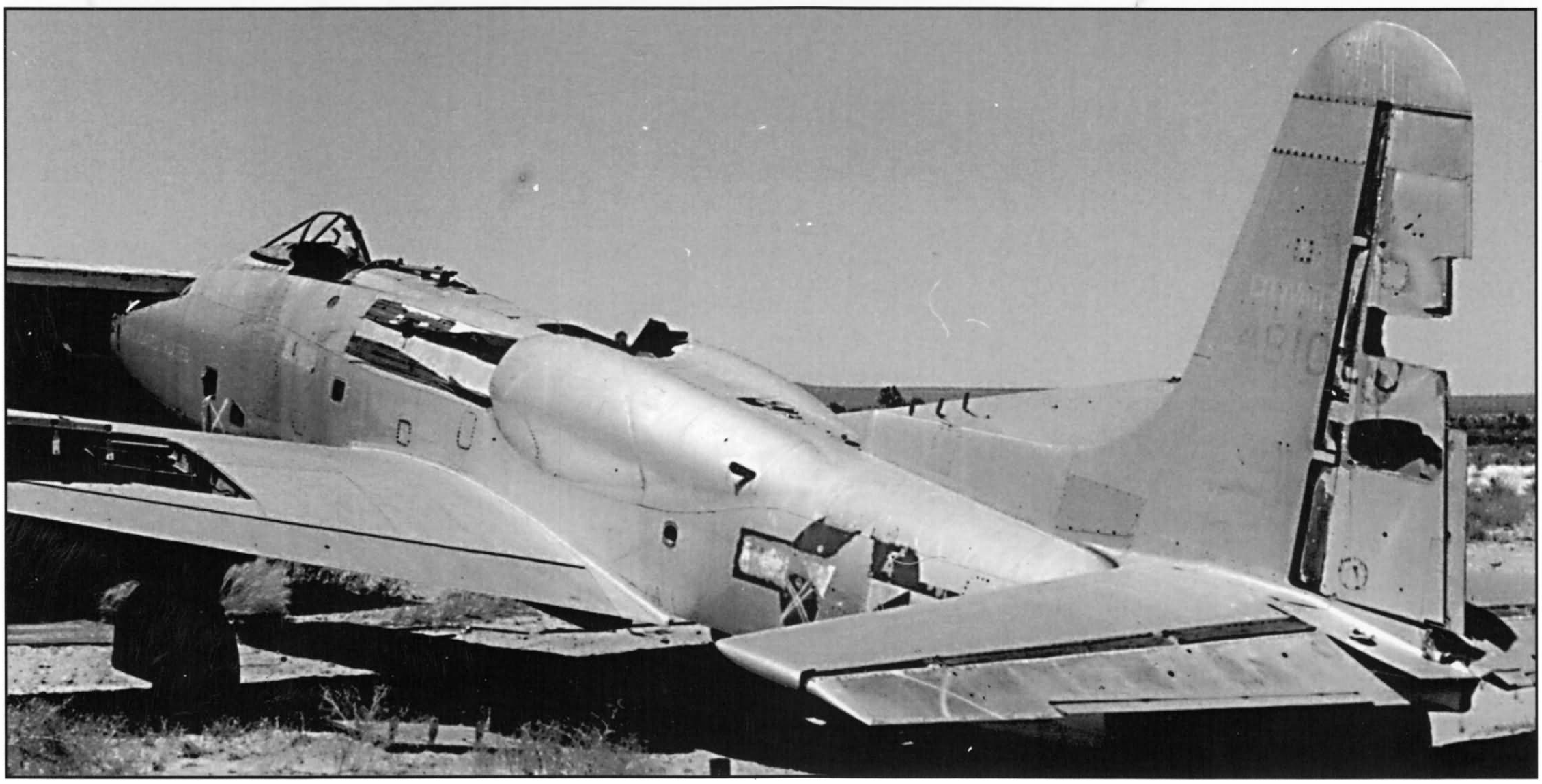


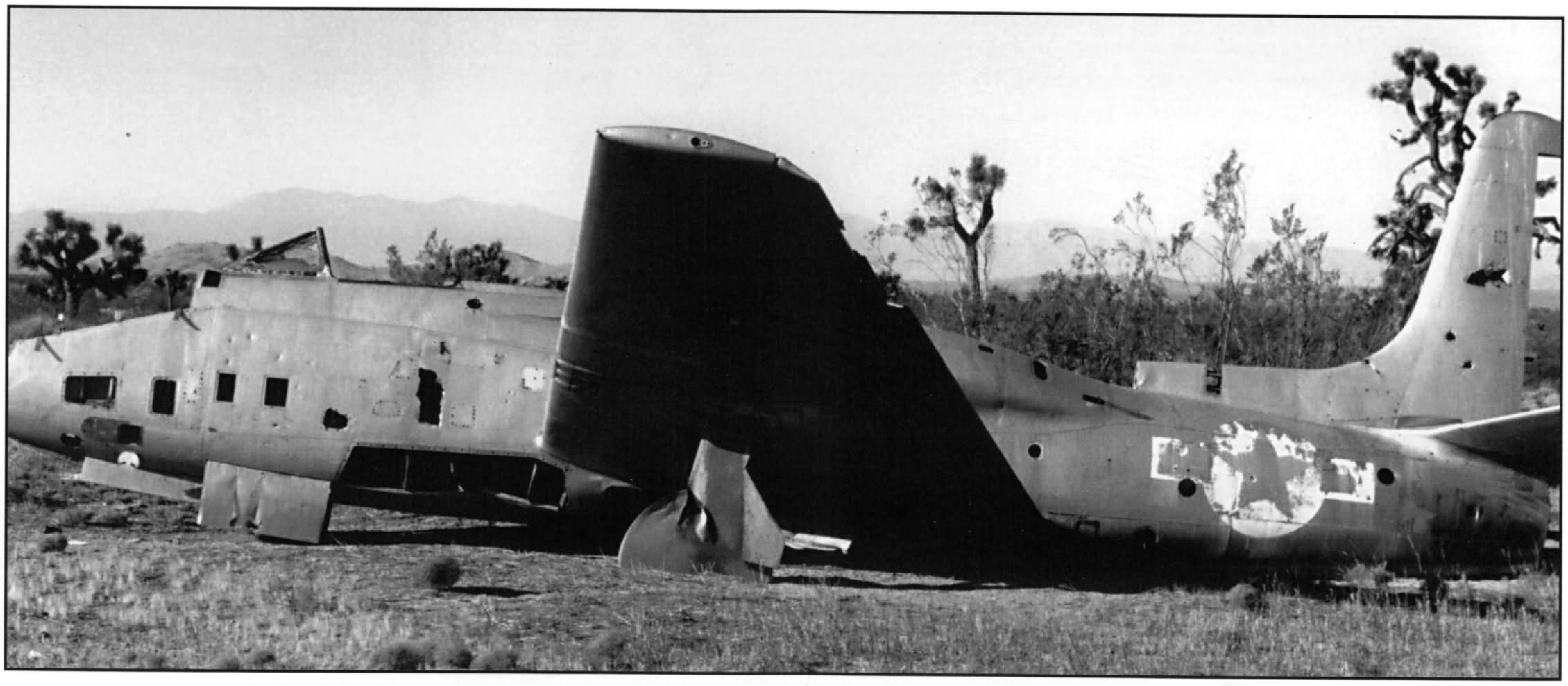
DESERT RETRIEVAL

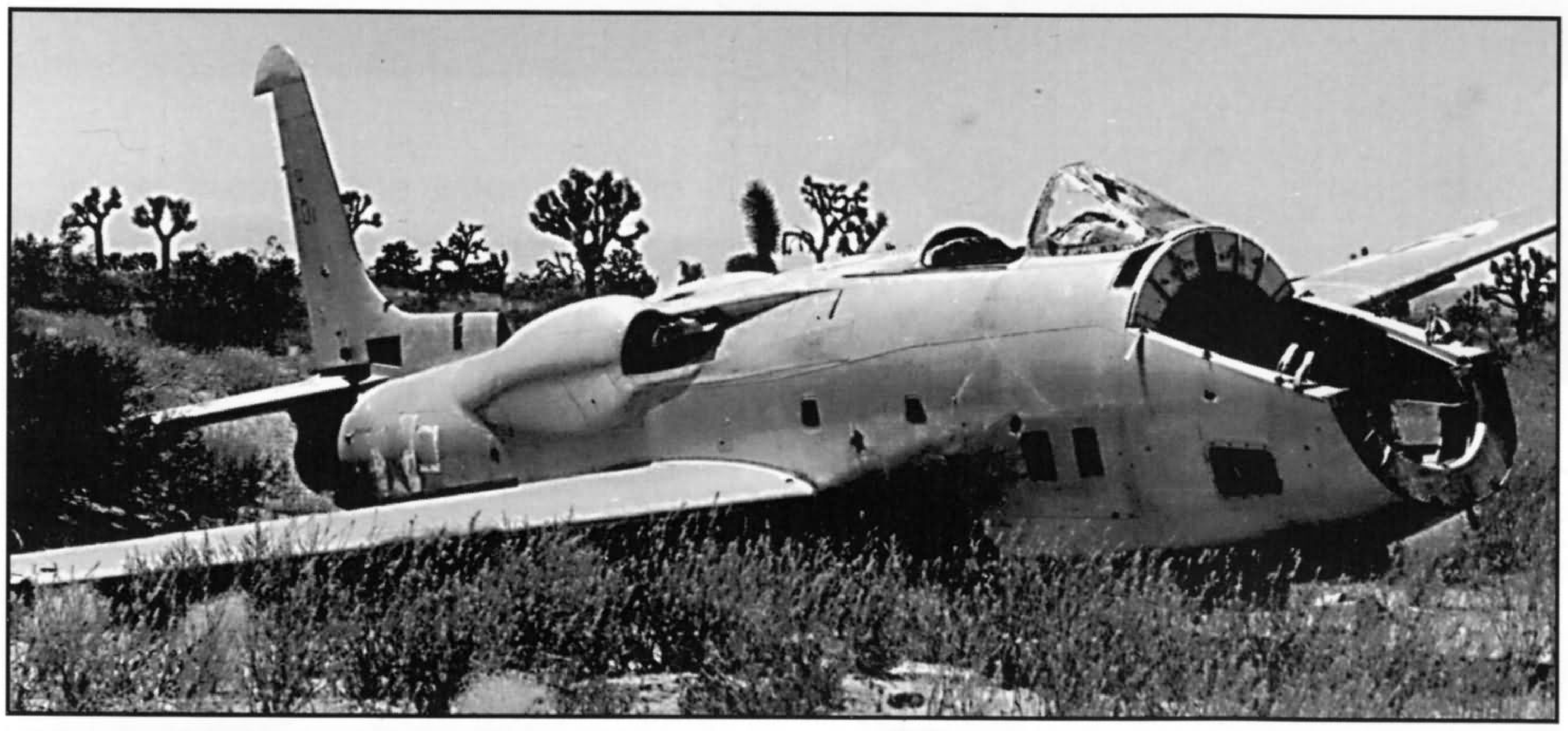
The first XP-81 44-91000 on the photo/bomb range at Edwards AFB prior to recovery. The dark areas on each side of the I-40 intakes are the remnants of the wood used to re-shape the intakes into NACA-style intakes. The final fin and rudder extensions can readily be seen due to corrosion of the mounting screws. At right, the ammo bay and inside ammo door details. This was the most complete airframe with the least damage. (AFFTCHO)



had been salvaged, the two aircraft were placed on a photographic and bombing range at Edwards. They remained there until August 1994



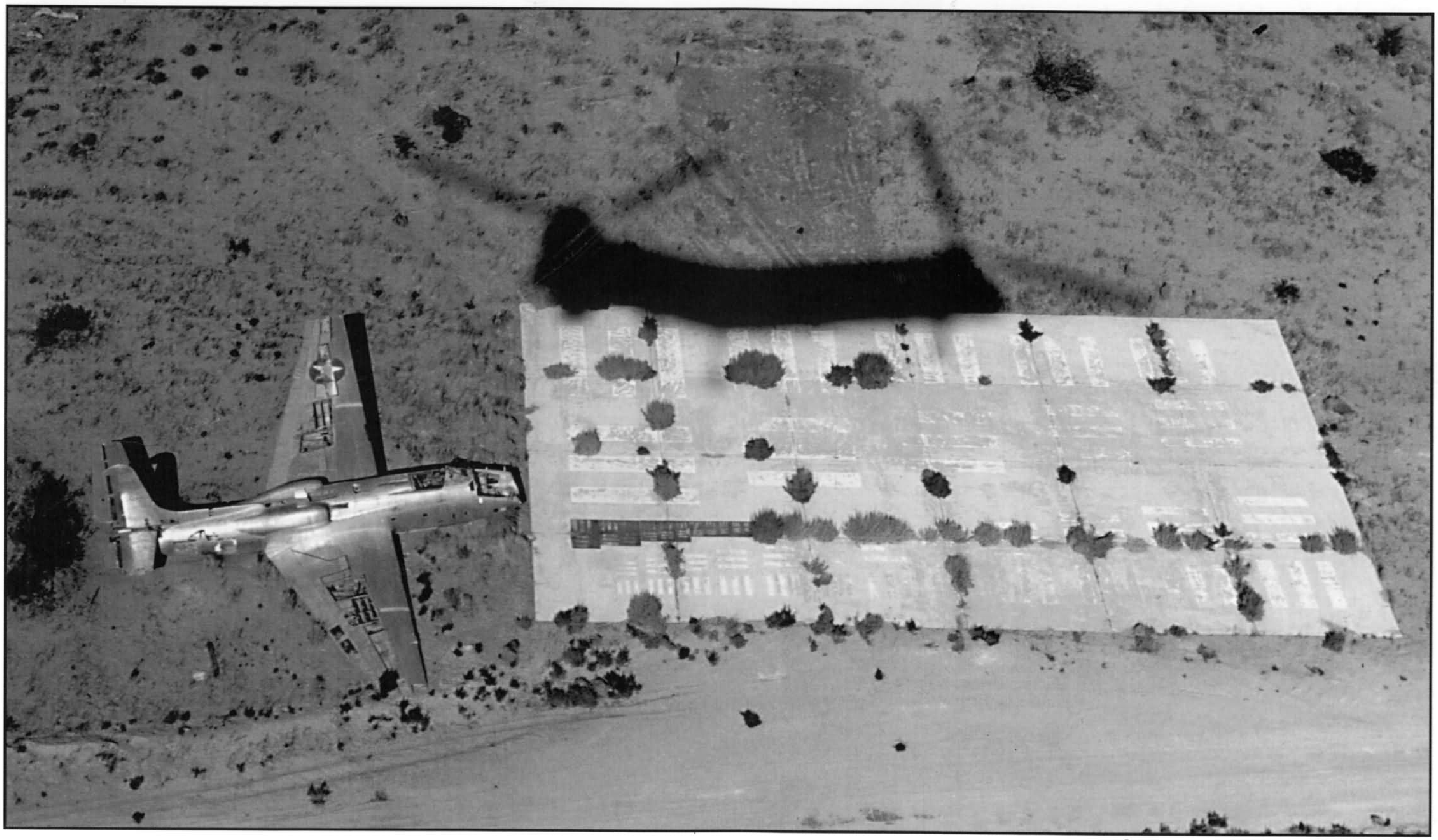


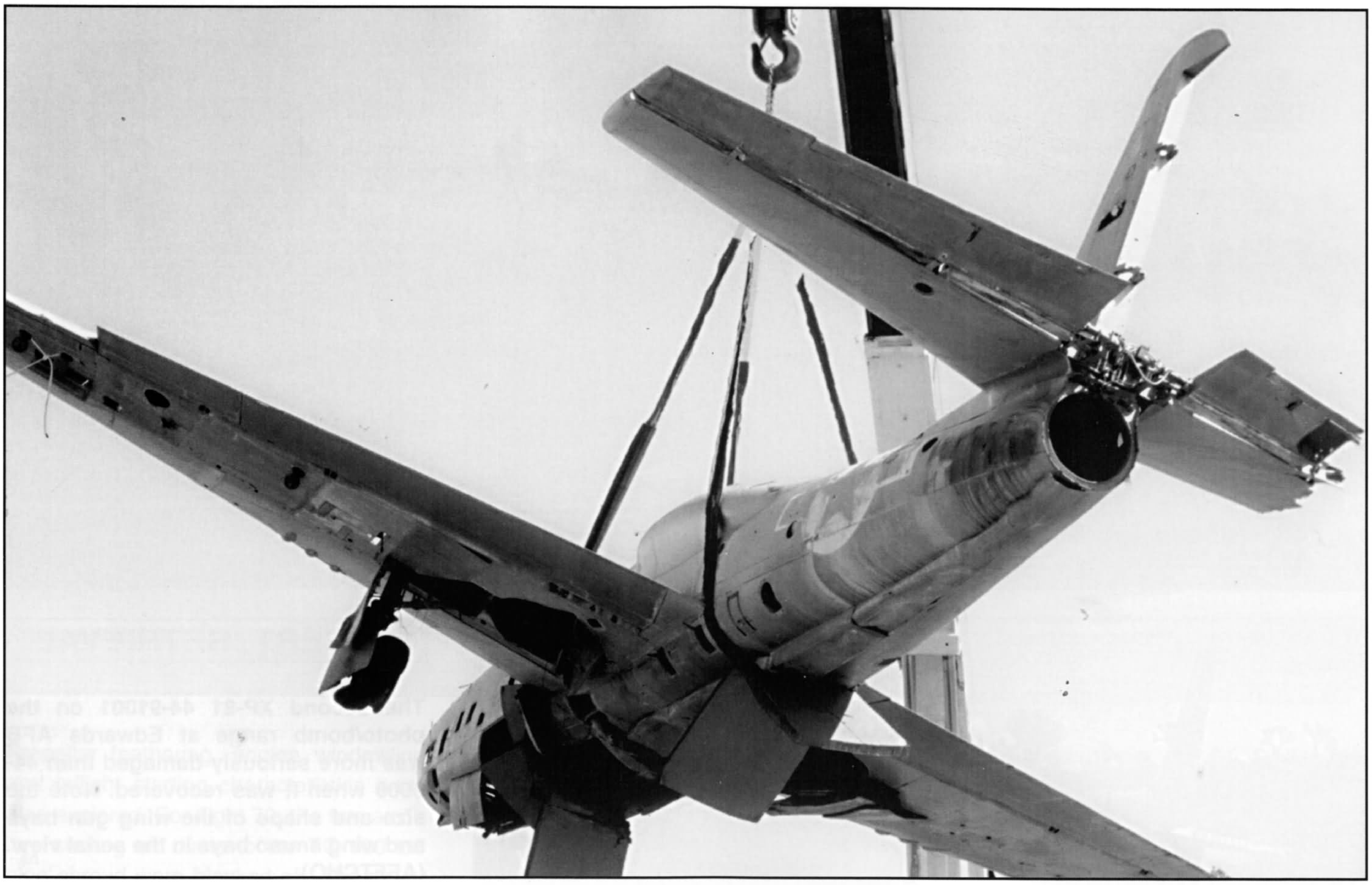


DESERT RETRIEVAL

The second XP-81 44-91001 on the photo/bomb range at Edwards AFB was more seriously damaged than 44-9000 when it was recovered. Note the size and shape of the wing gun bays and wing ammo bays in the aerial view. (AFFTCHO)

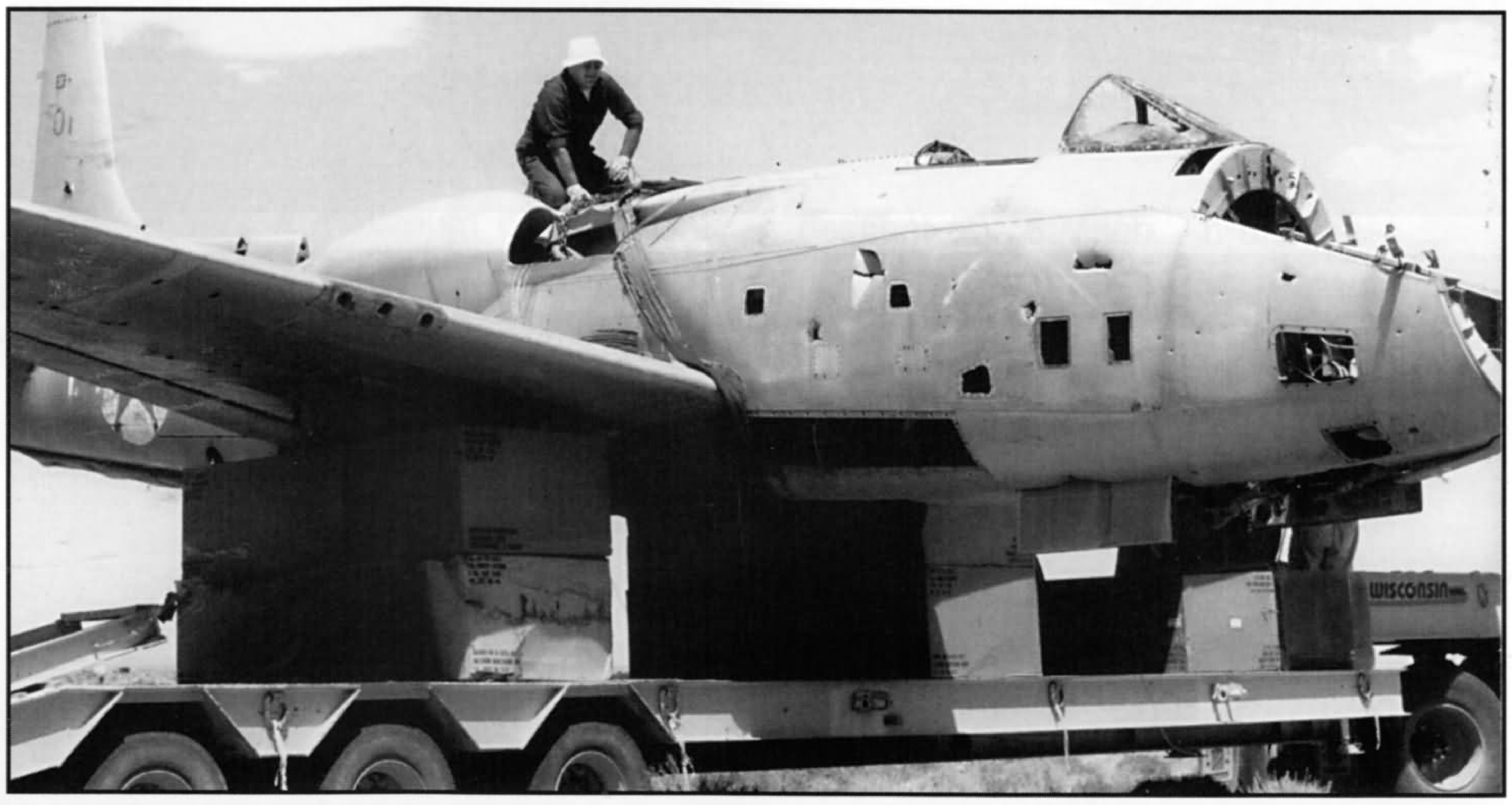
when they were retrieved by Doug



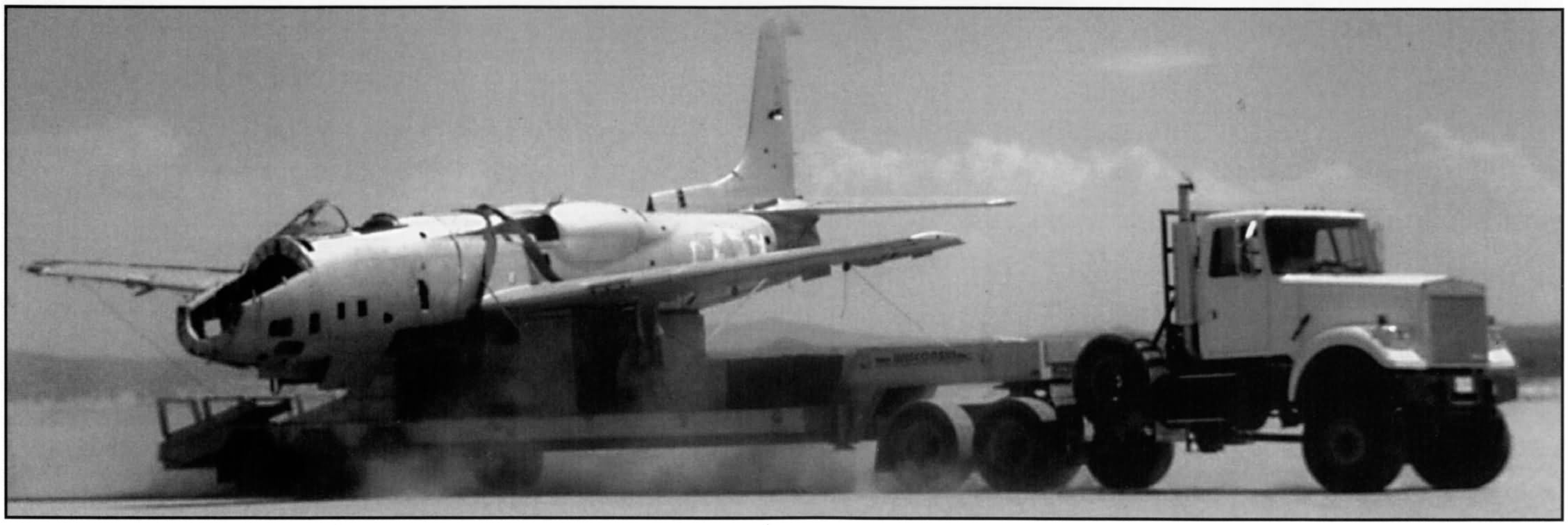


DESERT RETRIEVAL

Above, XP-81 44-91001 during recovery is being lifted by crane onto the flatbed trailer (above) then being tied down to the trailer (at right) and the aircraft hauled away for storage across Muroc dry lake. (AFFTCHO)



Nelson, curator at the Air Force Flight Test Center Museum. They have since been transferred to the Air Force Museum for restoration.



THE CONSOLIDATED VULTEE XP-81 DESCRIBED

GENERAL: The Consolidated Vultee XP-81 (Convair model 102) was a single place, long range, all metal, low wing, land monoplane, equipped with a tricycle landing gear. Power was supplied by a TG-100 (T-31) turbo-prop driving a 4-bladed prop and a I-40 (J33) turbojet in the aft fuselage.

DIMENSIONS:

Span	50ft 6in
Length	44ft 8in
Height (initial)	13ft 10in
Tread	14ft 6in
Wing Area	425sq ft
Sweep Back	0°
Wing Dihedral	6°
Root Cord	13-1

WEIGHTS:

Empty	12,755lbs
Normal	19,500lbs
(max internal fuel less armament)	
Max Combat	24,650lbs
Wing Loading	45.9#sq'
Tire Loading	80#sq"

CENTER OF GRAVITY:

Max Forward CG	17%
Max Aft CG	27%

ARMAMENT: Normal armament of 6-guns, either .50 cal (400-rounds each) or 20mm (200-rounds each) in groups of three in each wing could be fitted. One hard point was provided on each wing outboard of the guns which could accommodate various external bomb loads (2-each 100lbs up to 1,600lbs), depth charges, chemical tanks, rockets, and drop tanks. 14-5" HVAR rockets could be carried along the wings on stub pylons. The gun sight was a K-14.

FUEL:

Internal	811gal
With Wing Tanks	1,511gal

The two internal fuel tanks were located just aft of the pilot's cockpit.

OIL:

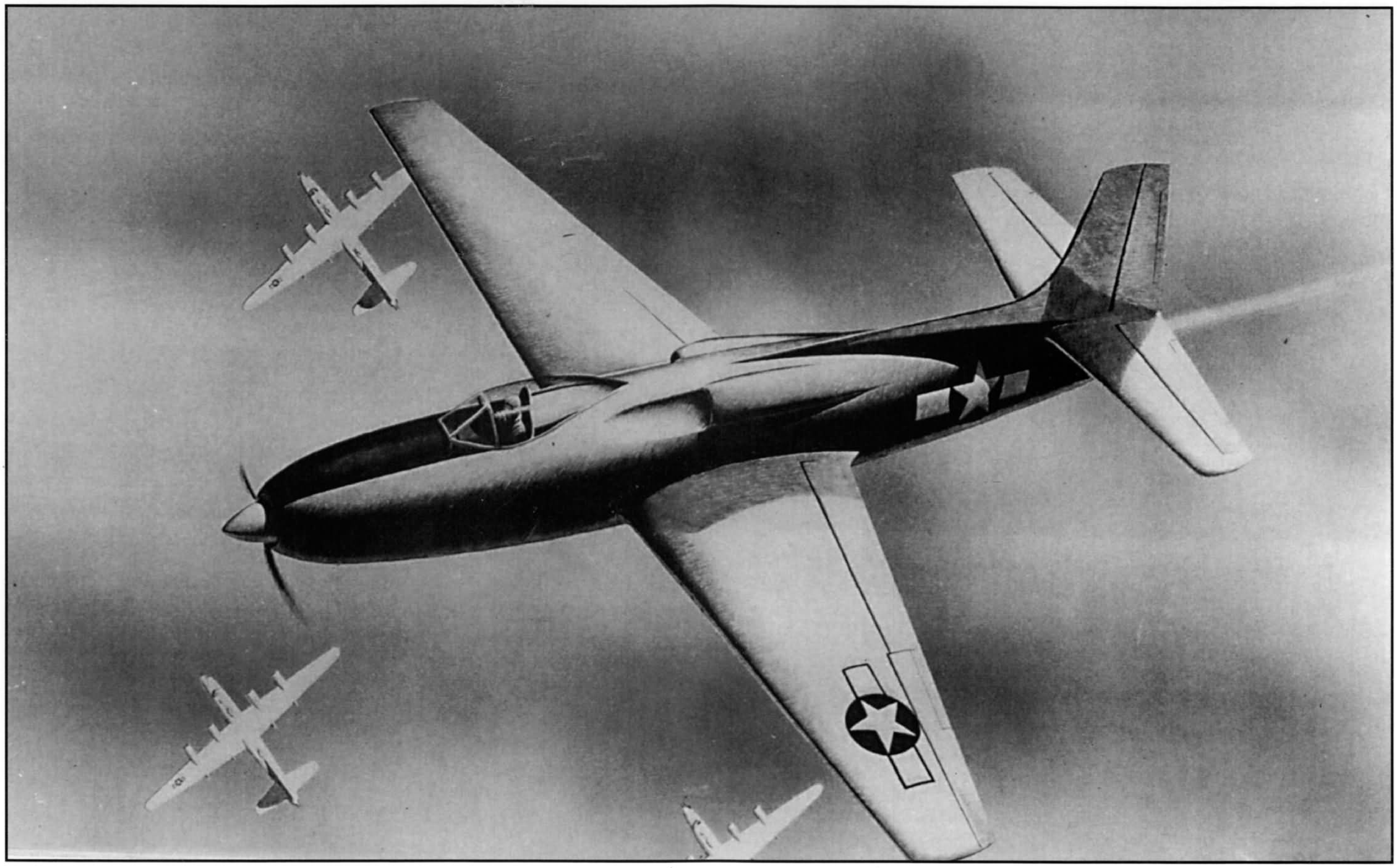
TG-100 (T-31)	8gal
I-40 (J33)	3.5gal

WING: The wing was a NACA laminar flow type. A smooth airfoil was applied by unique method of construction, which included the use of heavy aluminum-alloy skin. The stressed-skin wing was flush riveted and rivet heads were milled. Because of the heavy skin, no dimpling occured during assembly. Thus, a smooth aerodynamic surface was achieved without the necessity for painting and other treatment to fill-in depressions.

The heavy plating was applied on the forward 34.5% of the wing. This area encompassed the structural torsion box and main spar, extending to the centerline of the fuselage. The aft portion of the wing was semi-structural and provided adequate strength for support of equipment, ailerons and flaps. Spoilers on each wing operate automatically with aileron movement.

Thermal anti-icing was used to protect the wing and empennage surfaces from ice. Hot air derived from the pressurized air of the TG-100 engine and heat from the exhaust stack was ducted to the forward sections of the wing and tail surfaces.

Below, early 1945 artist concept of XP-81, note Consolidated B-32s not B-29s that the XP-81 was escorting. (USAF)



FUSELAGE: Extensive use of 24S-RT, age-hardened aluminum alloy was made in the fuselage. The semi-monocoque fuselage was flush riveted on the exterior surfaces.

LANDING GEAR: The tricycle landing gear was electrically operated with disc brakes on the main gear. The aircraft was also fitted with a parking brake.

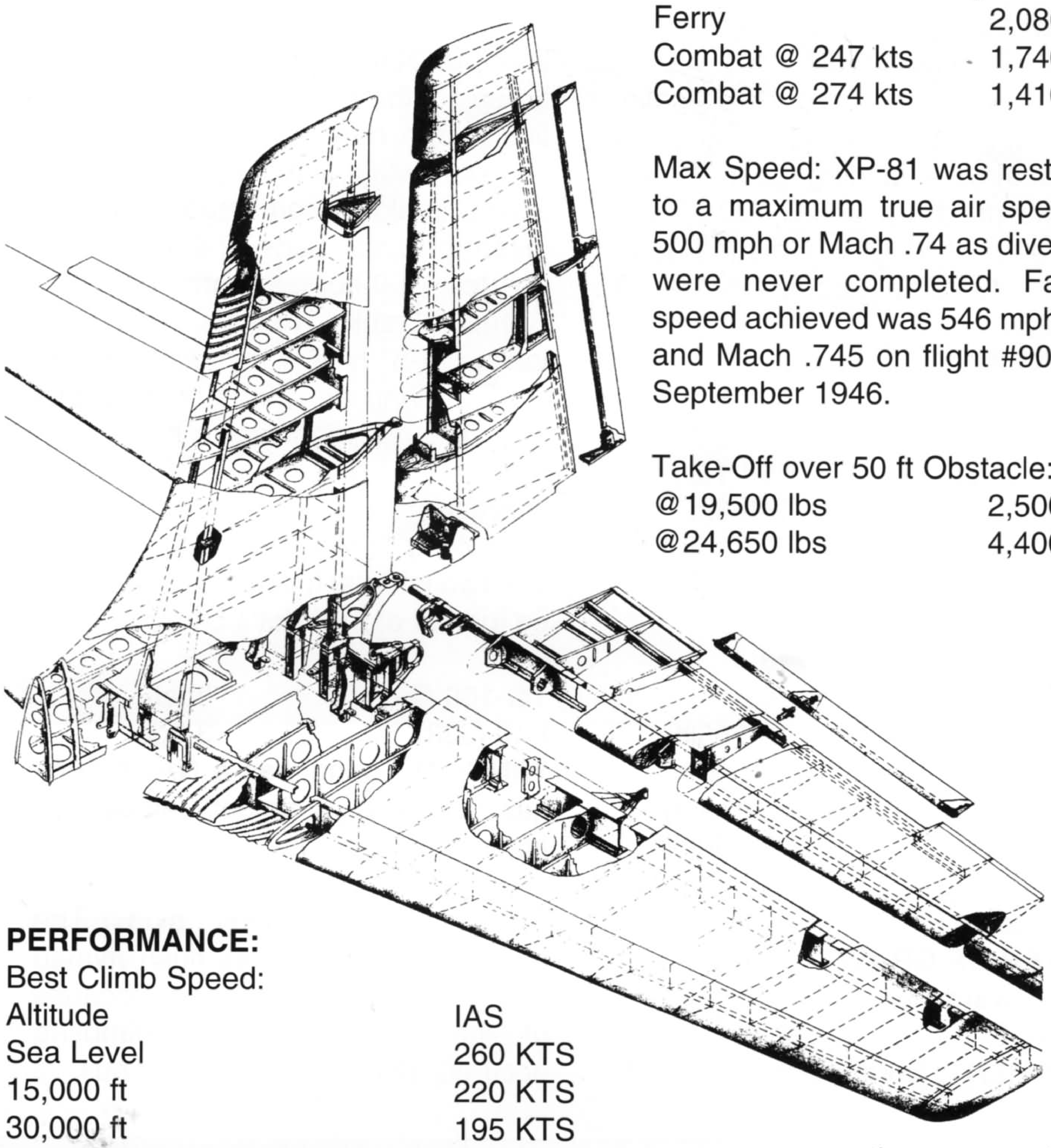
CANOPY and COCKPIT: The bubble-type canopy slid aft, and had stops provided for several intermediate positions. Opening or closing the canopy was accomplished by use of a hand crank on the left-hand side that was rotated in the direction of intended travel. The canopy was also provided with an emergency jettison control lever located in the forward left portion of the cockpit.

A standard WWII style pilot's seat was originally supplied, but was replaced with an ejection seat based on the one used in the Convair XP-54 fighter.

To improve pilot habitability during long escort flights, an automatic pilot was installed. The cabin was pressurized by air from the TG-100 compressor. Refrigeration was also provided to maintain comfortable cockpit conditions regardless of the climate or altitude.

RADIO: The XP-81 was equipped with a VHF (SCR 522-A) radio set. Provisions were made for a Beacon Receiver (BC-1206) and an IFF (SCR 695), but these were not installed. All radio controls were located on the right side of the cockpit.

TAIL GROUP



Range:
Maximum Combat Weight

Ferry	2,080 nmi
Combat @ 247 kts	1,740 nmi
Combat @ 274 kts	1,410 nmi

Max Speed: XP-81 was restricted to a maximum true air speed of 500 mph or Mach .74 as dive tests were never completed. Fastest speed achieved was 546 mph TAS and Mach .745 on flight #90 on 4 September 1946.

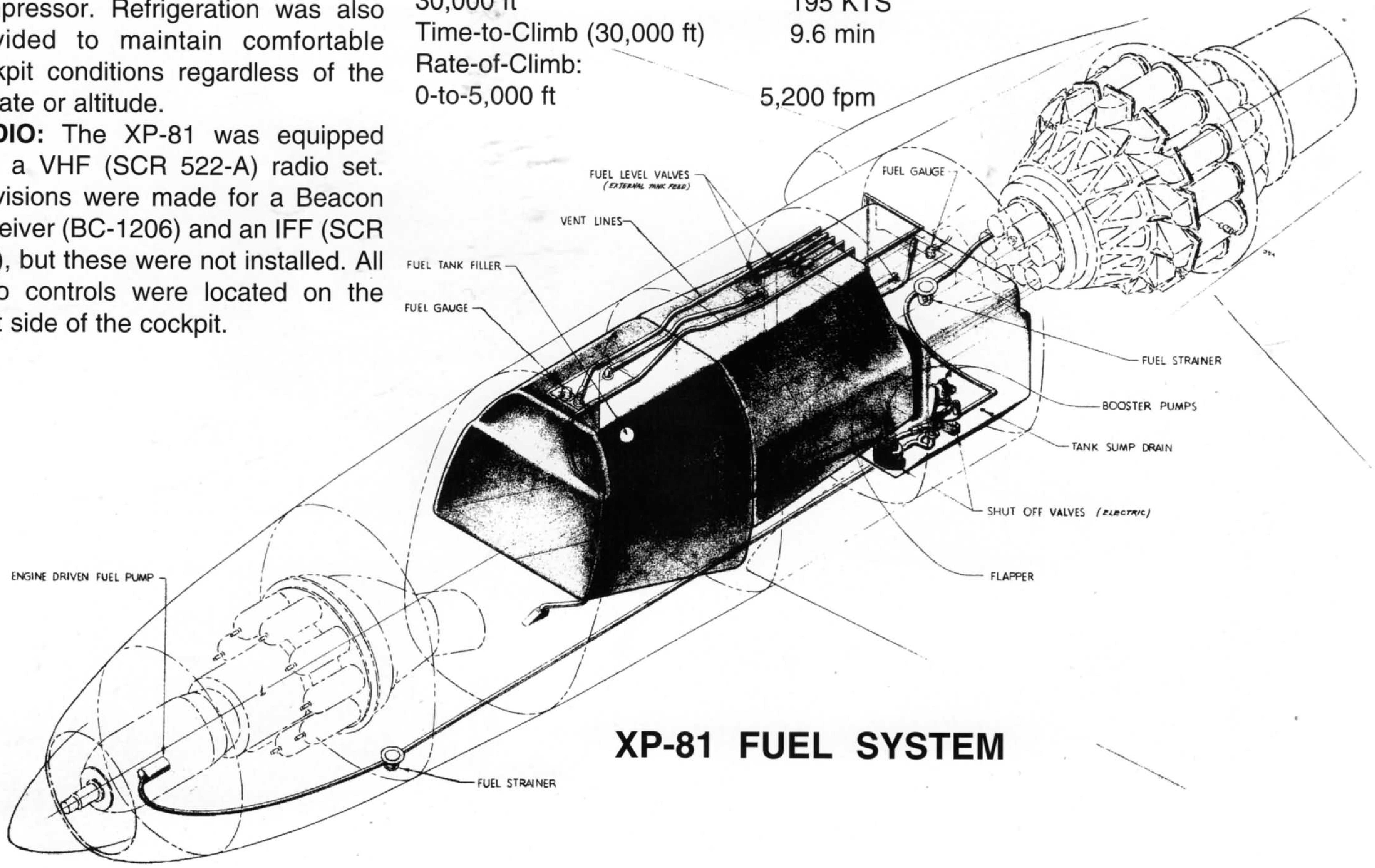
Take-Off over 50 ft Obstacle:

@19,500 lbs	2,500 ft
@24,650 lbs	4,400 ft

PERFORMANCE:

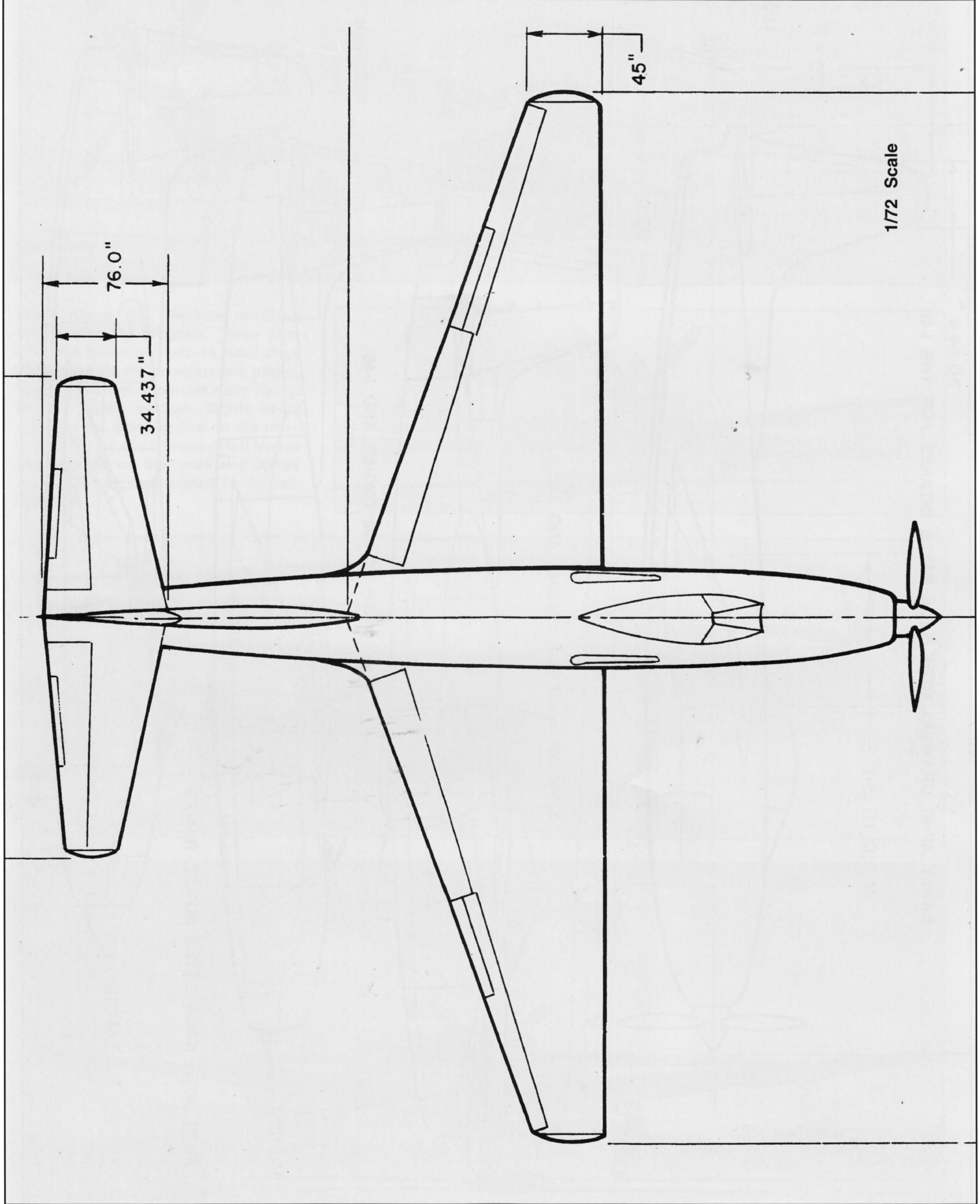
Best Climb Speed:

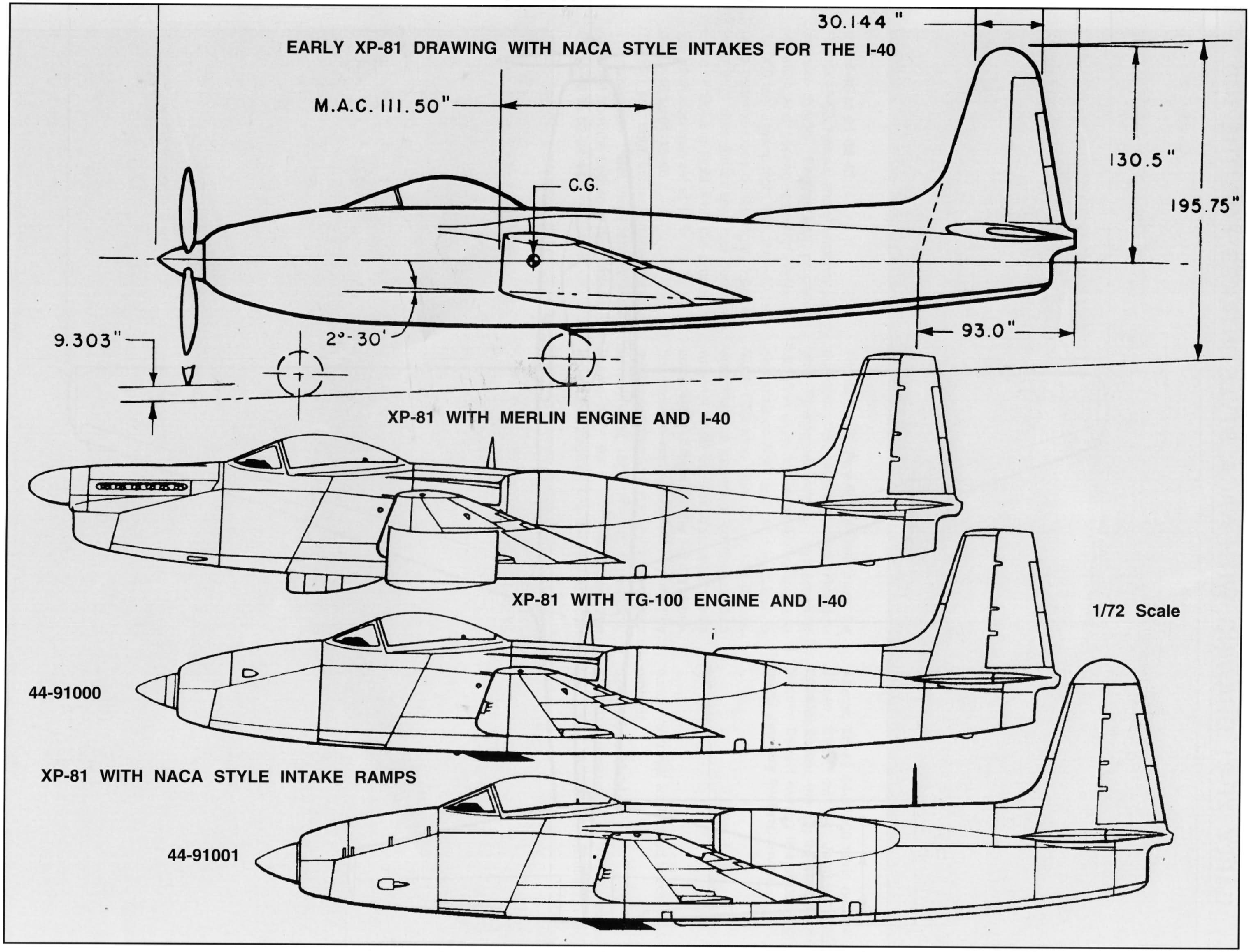
Altitude	IAS
Sea Level	260 KTS
15,000 ft	220 KTS
30,000 ft	195 KTS
Time-to-Climb (30,000 ft)	9.6 min
Rate-of-Climb:	
0-to-5,000 ft	5,200 fpm



XP-81 FUEL SYSTEM

EARLY XP-81 DRAWING WITH NACA STYLE INTAKES FOR THE I-40




EARLY XP-81 DRAWING WITH NACA STYLE INTAKES FOR THE I-40

XP-81 WITH MERLIN ENGINE AND I-40

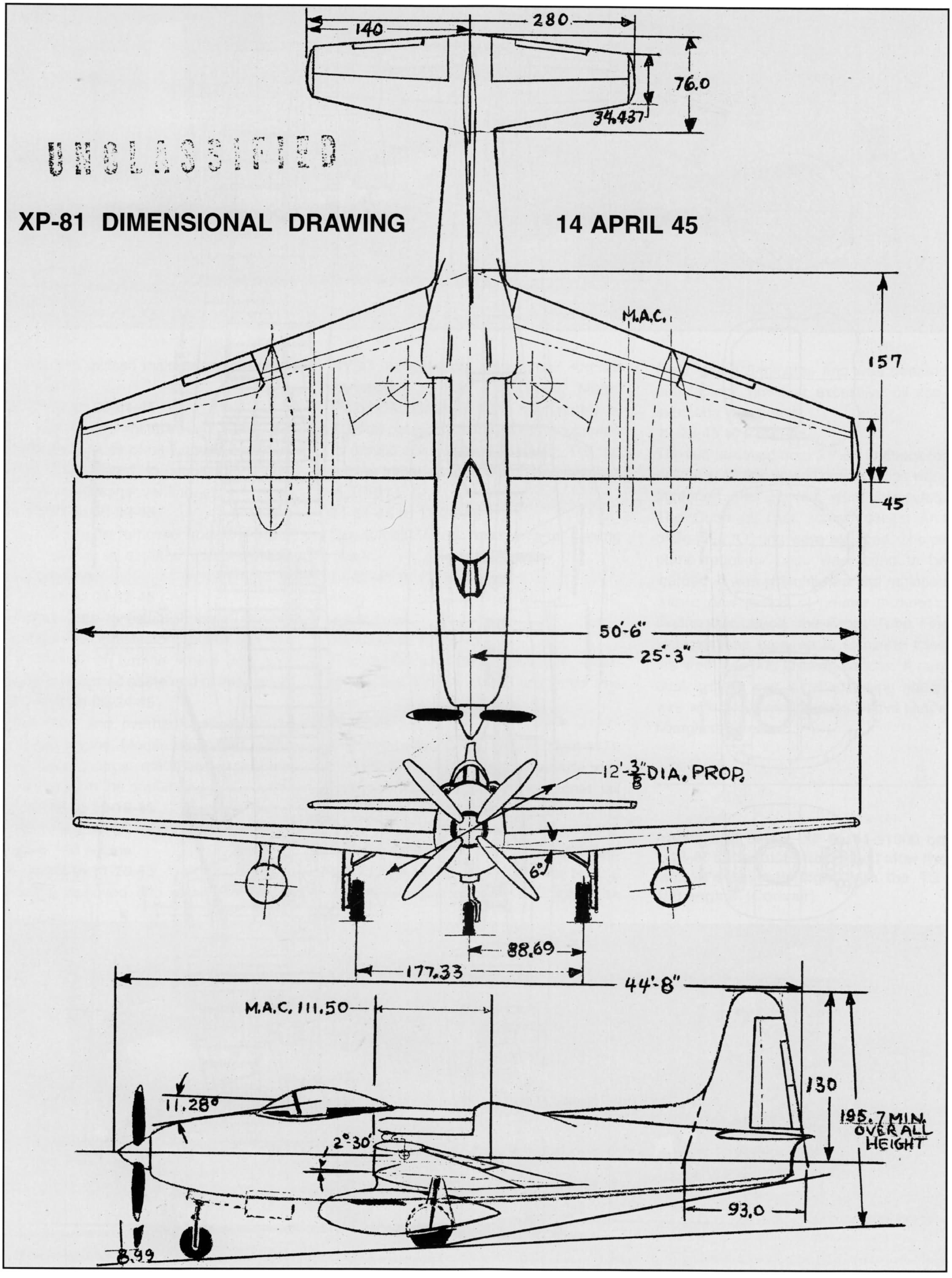
XP-81 WITH TG-100 ENGINE AND I-40

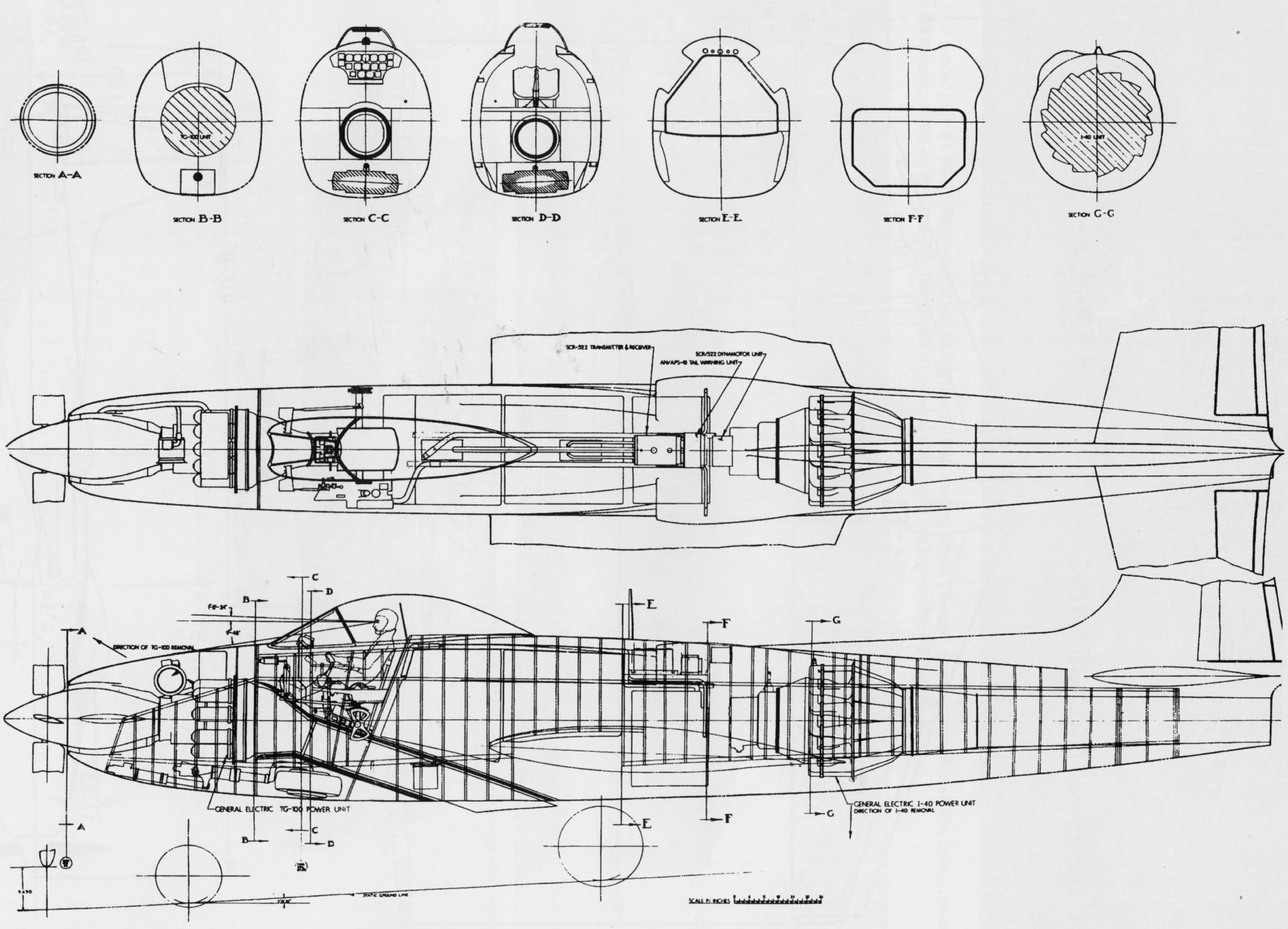
1/72 Scale

XP-81 WITH NACA STYLE INTAKE RAMPS

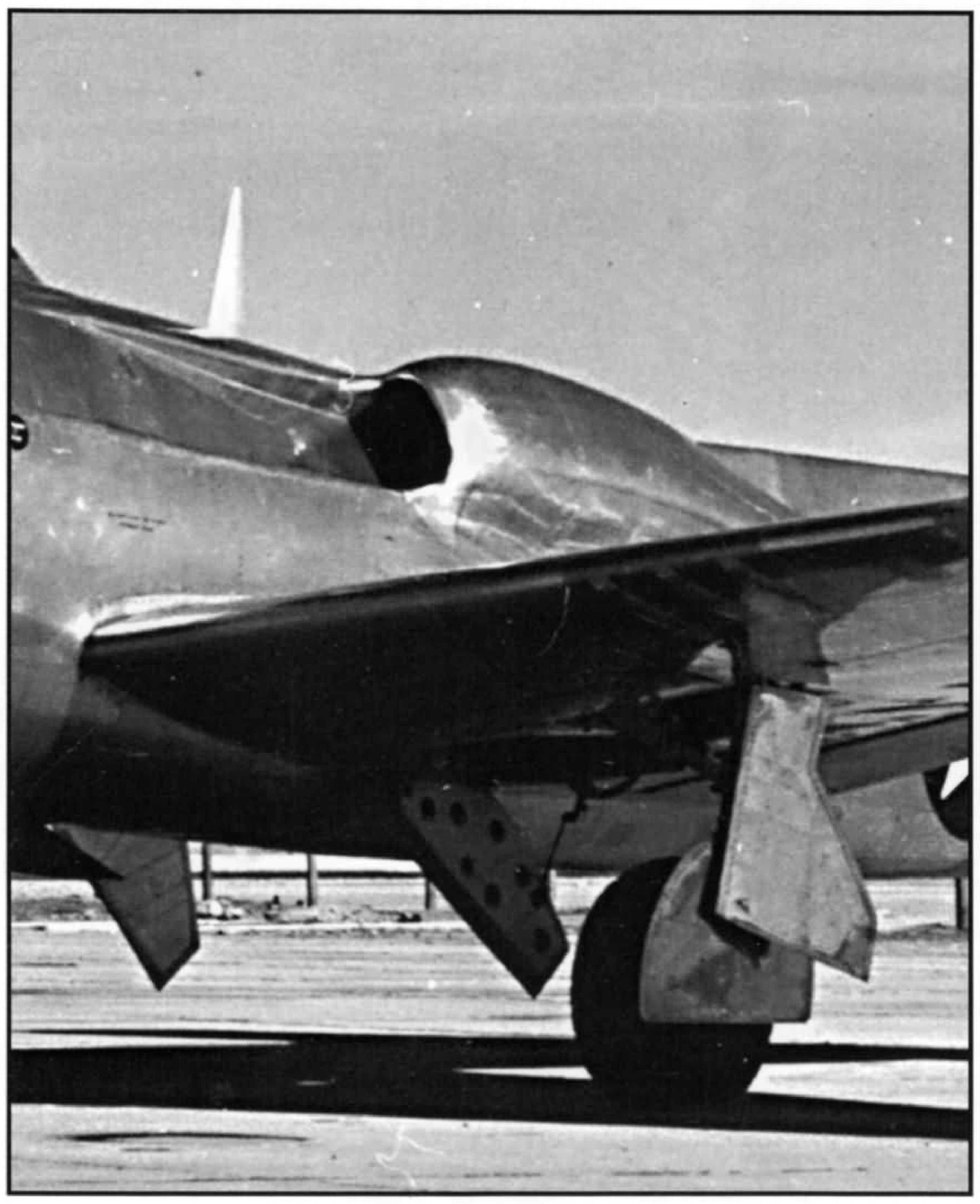
UNCLASSIFIED

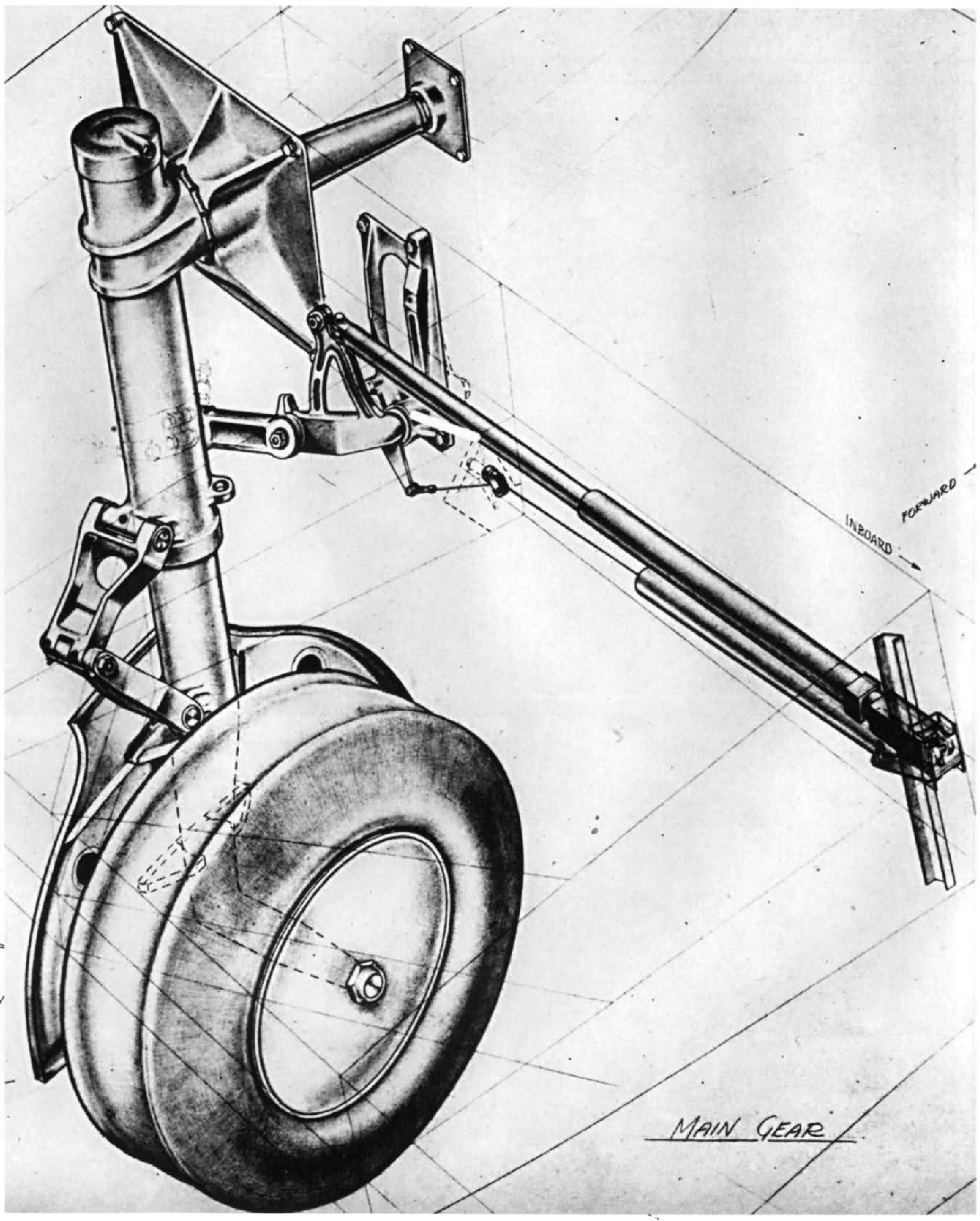
XP-81 DIMENSIONAL DRAWING 14 APRIL 45

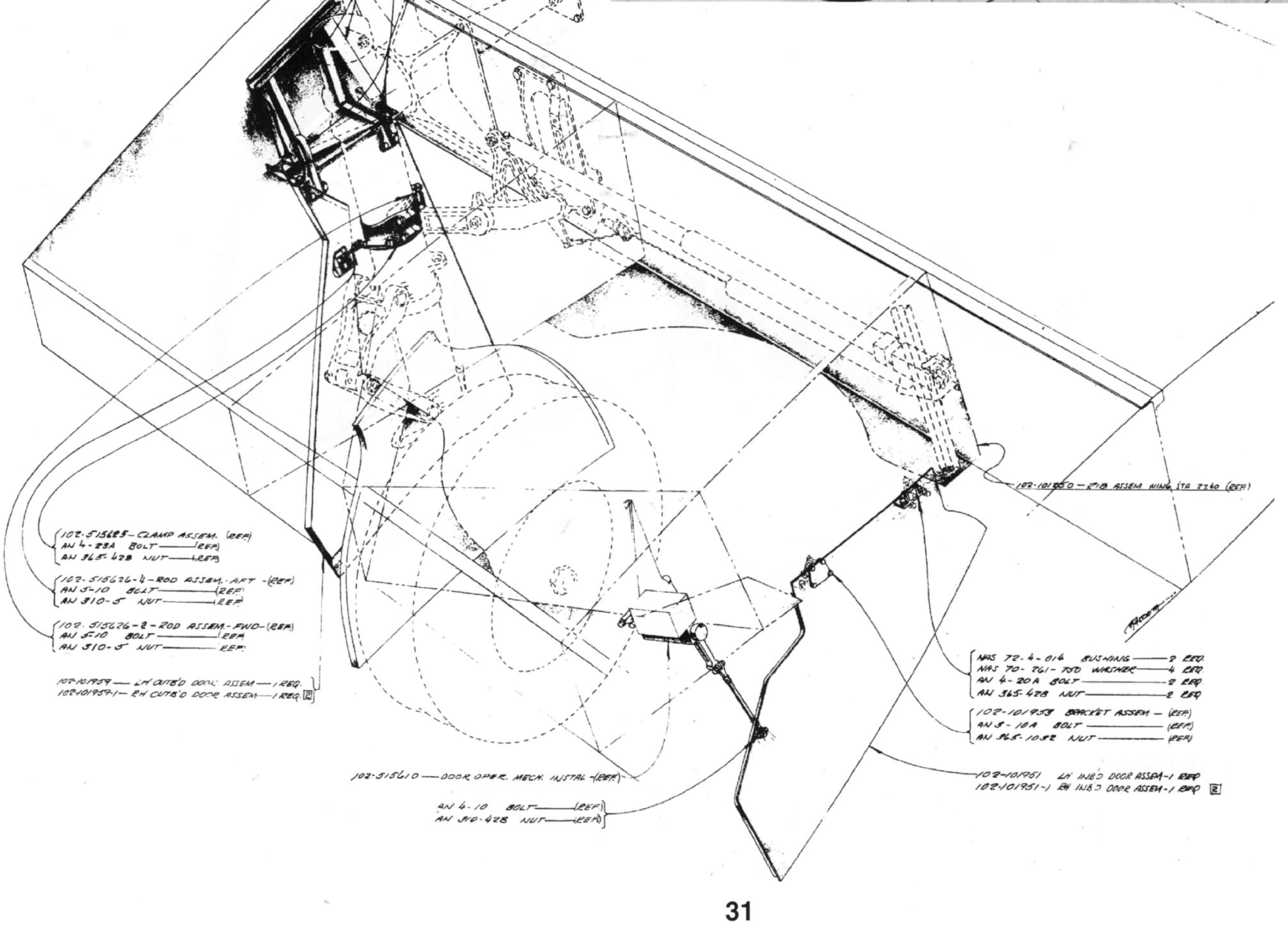



SECTION A-A
SECTION B-B
TG-100 UNIT
SECTION C-C
SECTION D-D
SECTION E-E
SECTION F-F
SECTION G-G
I-40 UNIT
SCR-522 TRANSMITTER & RECEIVER
SCR/522 DYNAMOTOR UNIT
AN/APS-13 TAIL WARNING UNIT
DIRECTION OF TG-100 REMOVAL
GENERAL ELECTRIC TG-100 POWER UNIT
GENERAL ELECTRIC I-40 POWER UNIT
DIRECTION OF I-40 REMOVAL
A
B
C
D
E
F
G
STATIC GROUND LINE
SCALE IN INCHES

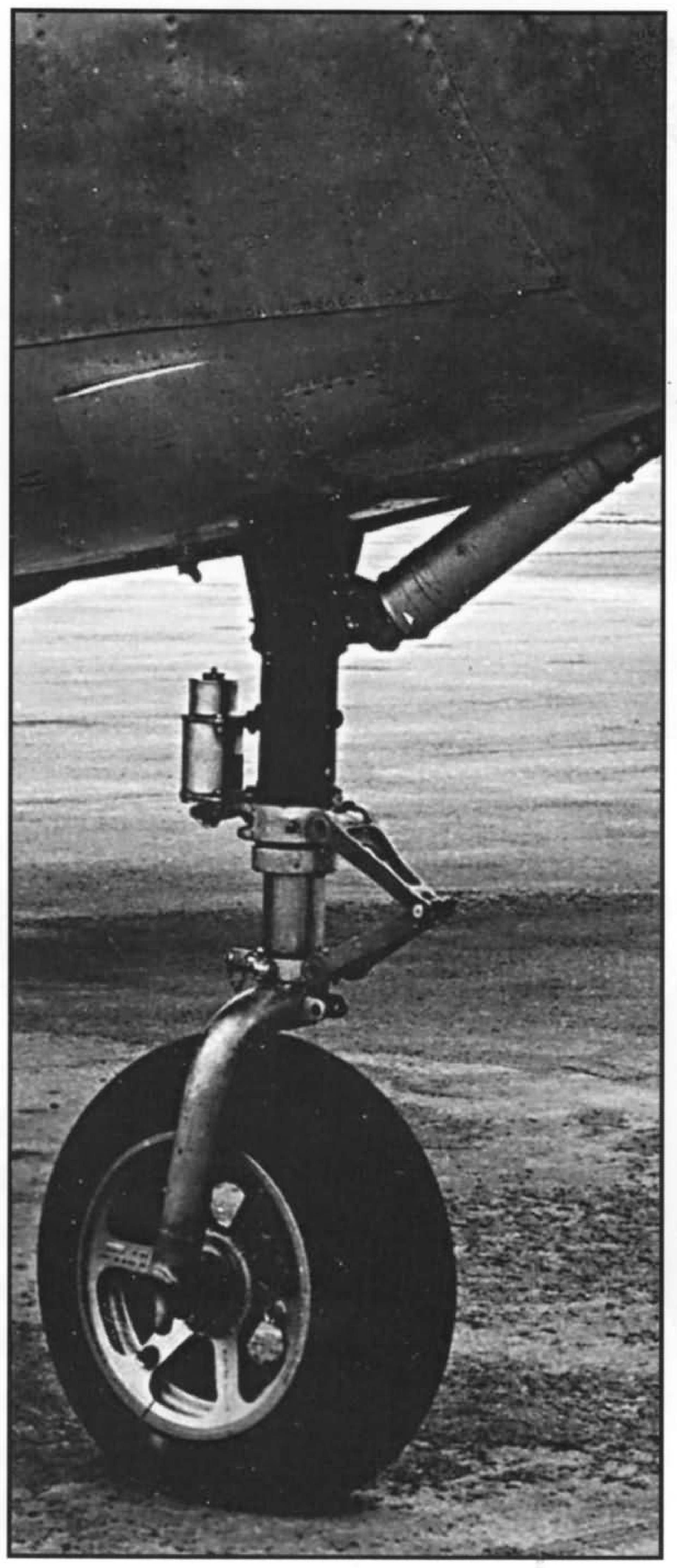
XP-81 MAIN LANDING GEAR

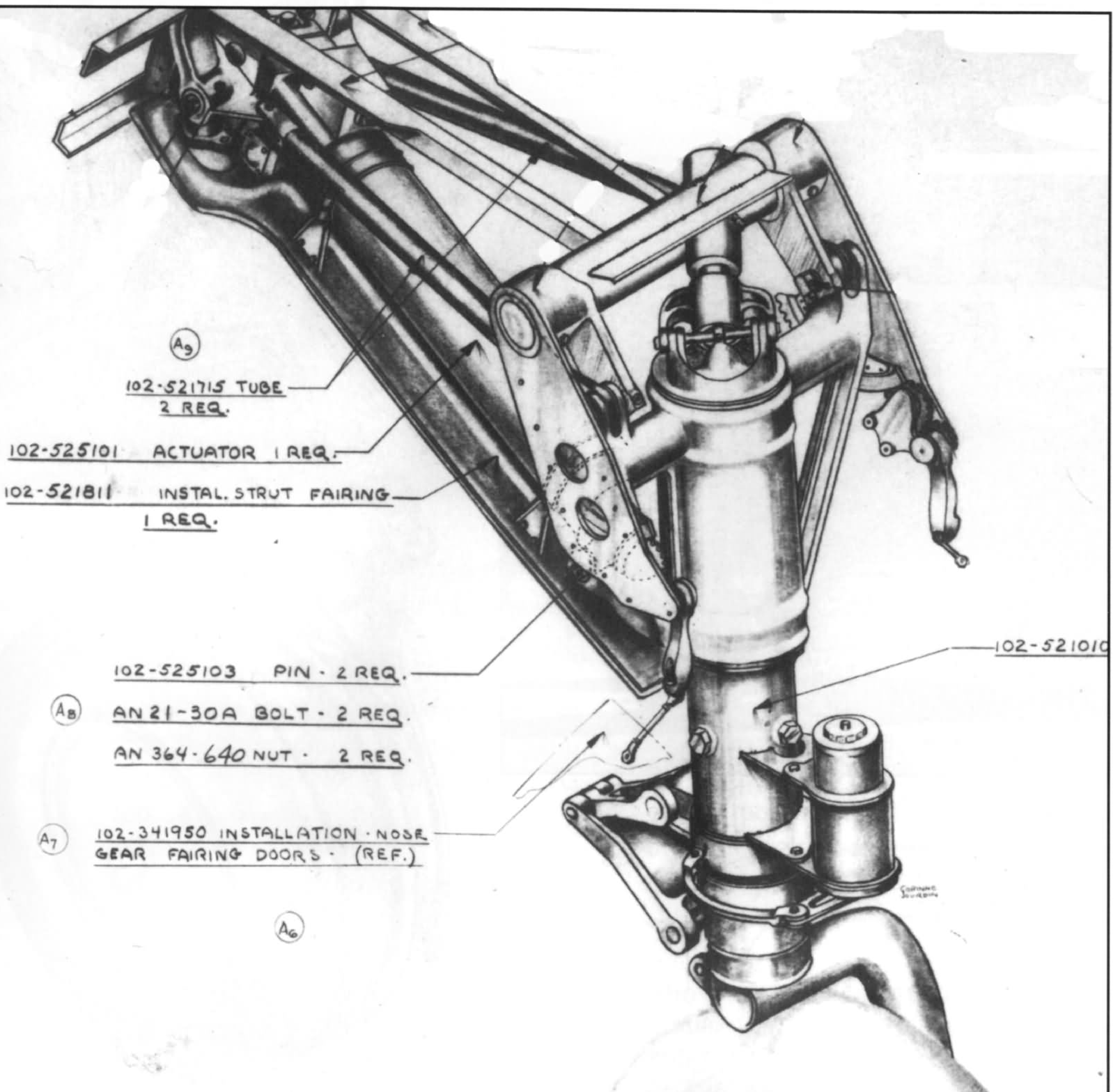


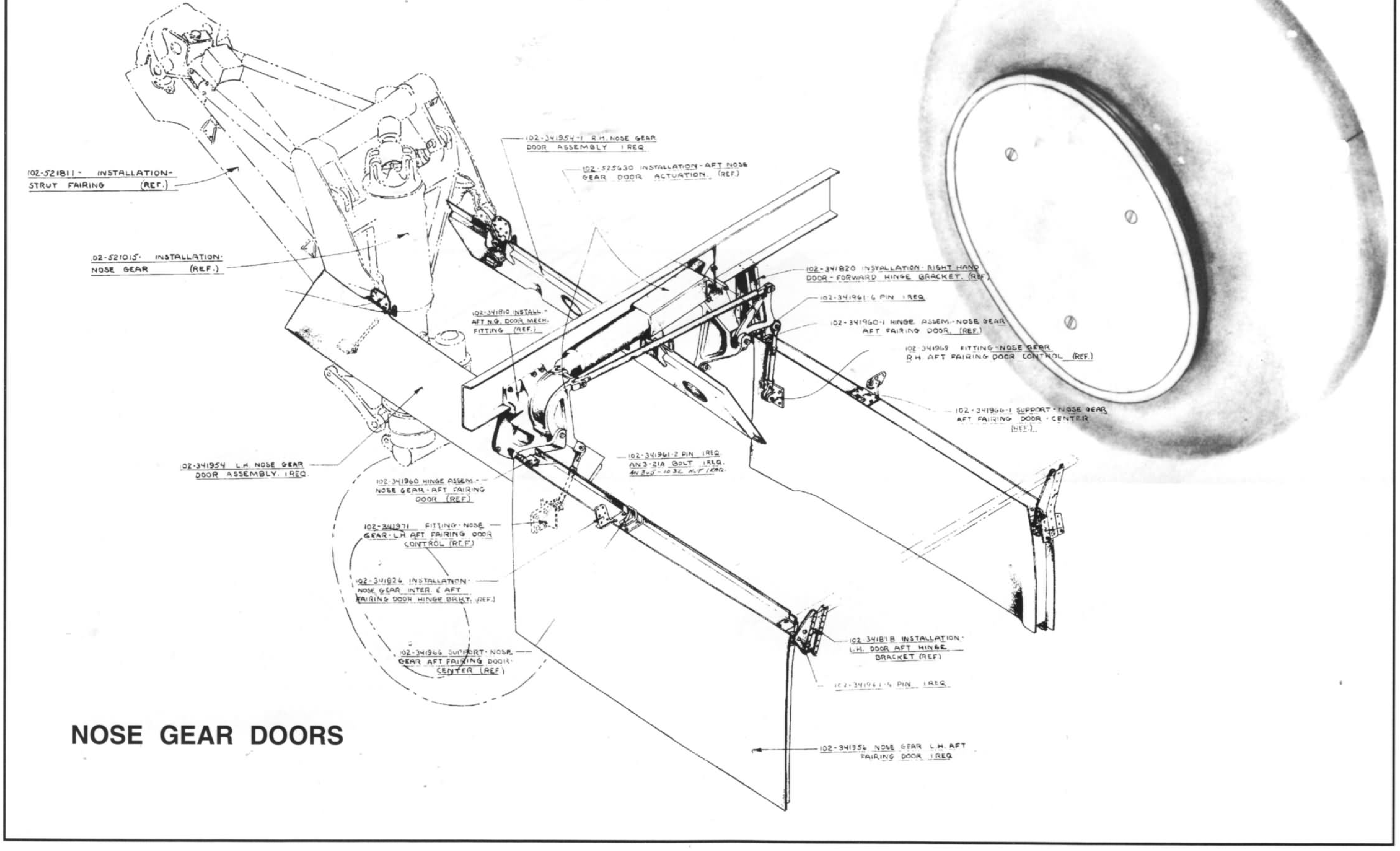



102-511015 — MAIN GEAR INSTAL — (REF)
AN 4-12A BOLT — 2 REQ.
NAS 72-4-101 BUSHING — 2 REQ.
AN 365-428 NUT — 2 REQ.
102-101898 — HINGE BOLT INSTAL. (REF.)
102-101950 — RIB ASSEM. WING STA 2240 (REF.)
102-515625 — CLAMP ASSEM. (REF)
AN 4-23A BOLT — (REF)
AN 365-428 NUT — (REF)
102-515626-4 — ROD ASSEM. - AFT - (REF)
AN 5-10 BOLT — (REF)
AN 310-5 NUT — REF
102-515626-2 — ROD ASSEM. - FWD - (REF)
AN 5-10 BOLT — REF
AN 310-5 NUT — REF
102-101959 — LH OUTB'D DOOR ASSEM — 1 REQ.
102-101959-1 — RH OUTB'D DOOR ASSEM — 1 REQ. 2
NAS 72-4-014 BUSHING — 2 REQ.
NAS 70-761-750 WASHER — 4 REQ.
AN 4-20A BOLT — 2 REQ.
AN 365-428 NUT — 2 REQ.
102-101953 BRACKET ASSEM — (REF)
AN 5-16A BOLT — (REF.)
AN 365-1032 NUT — (REF)
102-515610 — DOOR OPER. MECH. INSTAL — (REF.)
AN 4-10 BOLT — (REF.)
AN 310-428 NUT — (REF)
102-101951 LH INB'D DOOR ASSEM - 1 REQ
102-101951-1 RH INB'D DOOR ASSEM - 1 REQ 2

XP-81 NOSE LANDING GEAR

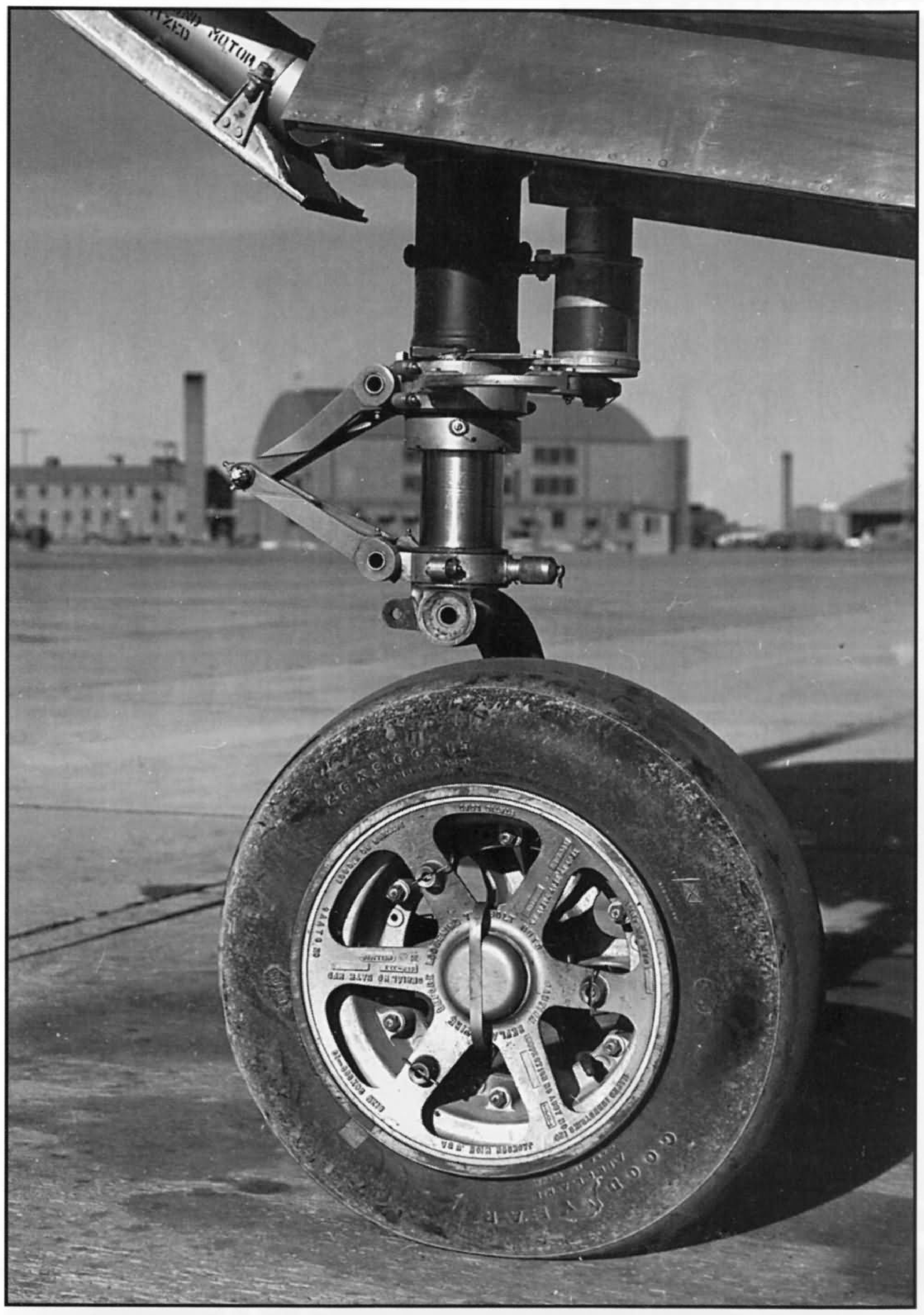


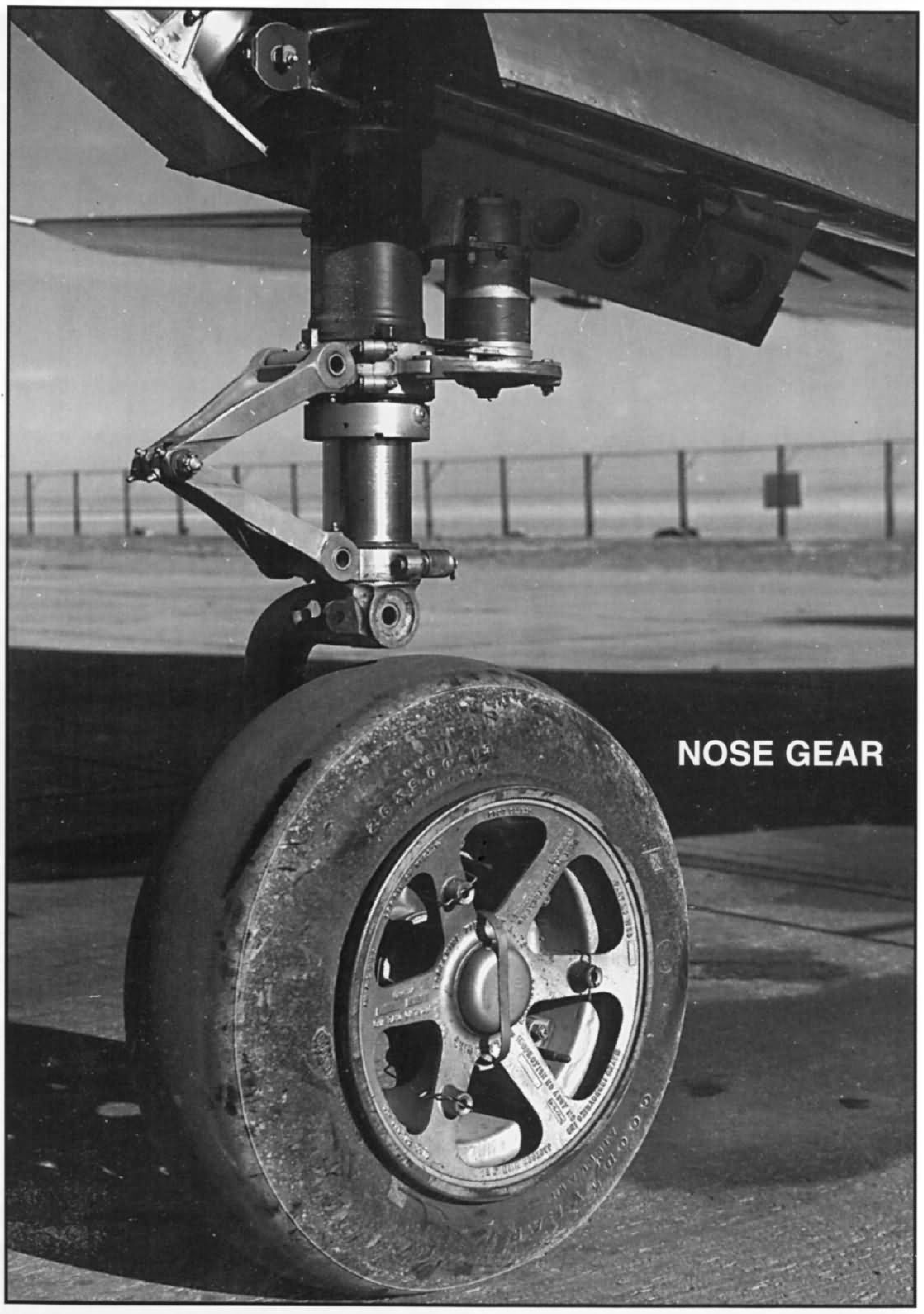

A9
102-521715 TUBE 2 REQ.
102-525101 ACTUATOR 1 REQ.
102-521811 INSTAL. STRUT FAIRING 1 REQ.
102-525103 PIN - 2 REQ.
A8
AN 21-30A BOLT - 2 REQ.
AN 364-640 NUT - 2 REQ.
A7
102-341950 INSTALLATION - NOSE GEAR FAIRING DOORS - (REF.)
A6
102-52101


102-521811 - INSTALLATION - STRUT FAIRING (REF.)
02-521015 - INSTALLATION - NOSE GEAR (REF.)
102-341954-1 R.H. NOSE GEAR DOOR ASSEMBLY 1 REQ
102-525630 INSTALLATION - AFT NOSE GEAR DOOR ACTUATION (REF.)
102-341810 INSTALL. - AFT N.G. DOOR MECH. FITTING (REF.)
102-341820 INSTALLATION - RIGHT HAND DOOR - FORWARD HINGE BRACKET (REF.)
102-341961-6 PIN 1 REQ
102-341960-1 HINGE ASSEM. - NOSE GEAR AFT FAIRING DOOR (REF.)
102-341969 FITTING - NOSE GEAR R.H. AFT FAIRING DOOR CONTROL (REF.)
102-341966-1 SUPPORT - NOSE GEAR AFT FAIRING DOOR - CENTER (REF.)
102-341954 L.H. NOSE GEAR DOOR ASSEMBLY 1 REQ
102-341961-2 PIN 1 REQ
AN3-21A BOLT 1 REQ.
AN 365-1032 NUT 1 REQ.
102-341960 HINGE ASSEM. - NOSE GEAR - AFT FAIRING DOOR (REF.)
102-341971 FITTING - NOSE GEAR - LH AFT FAIRING DOOR CONTROL (REF.)
102-341826 INSTALLATION - NOSE GEAR INTER. & AFT FAIRING DOOR HINGE BRKT. (REF.)
102-341966 SUPPORT - NOSE GEAR AFT FAIRING DOOR - CENTER (REF.)
102-341818 INSTALLATION - L.H. DOOR AFT HINGE BRACKET (REF.)
102-341961-4 PIN 1 REQ
102-341956 NOSE GEAR L.H. AFT FAIRING DOOR 1 REQ

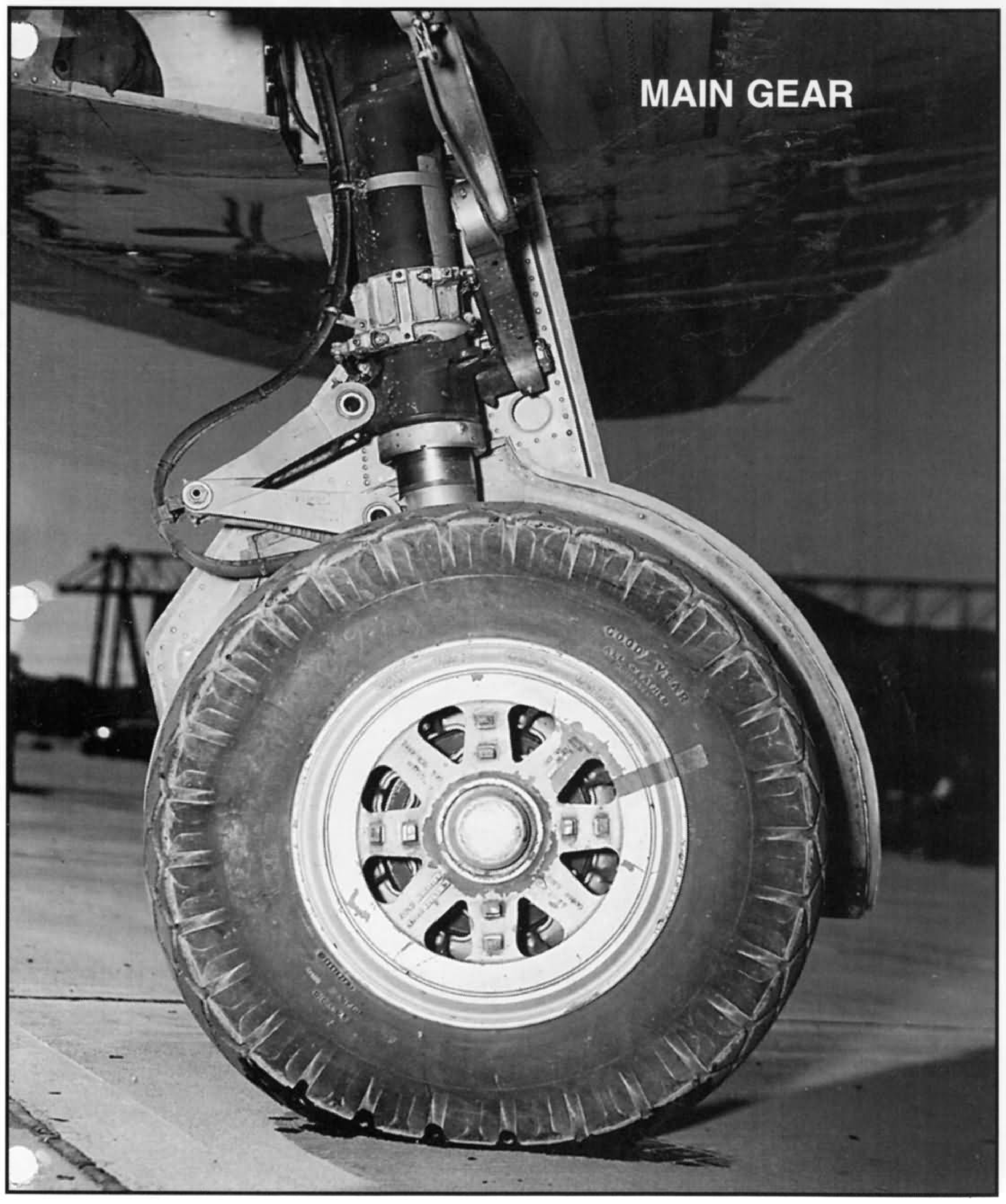
NOSE GEAR DOORS

XP-81 LANDING GEAR

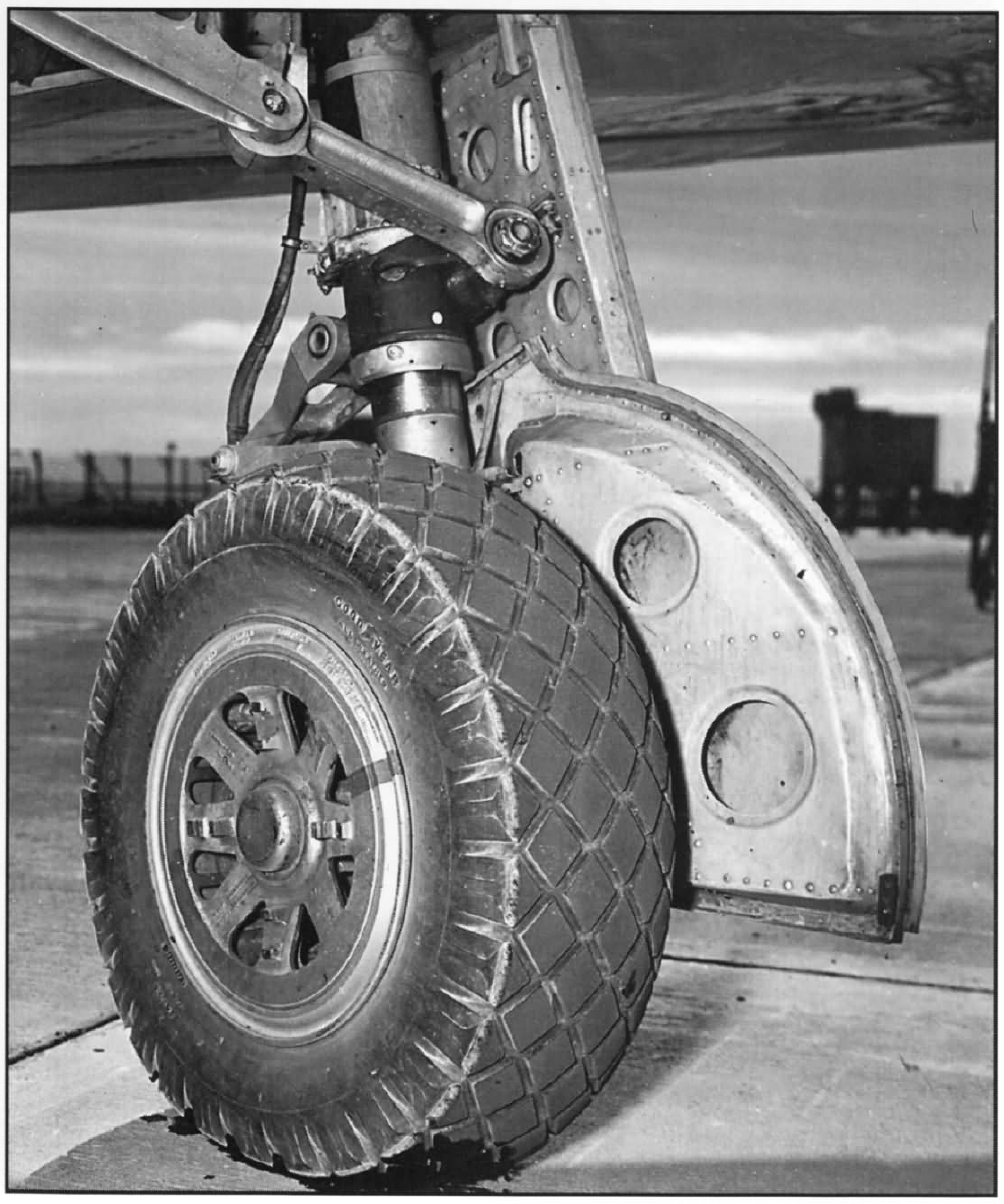




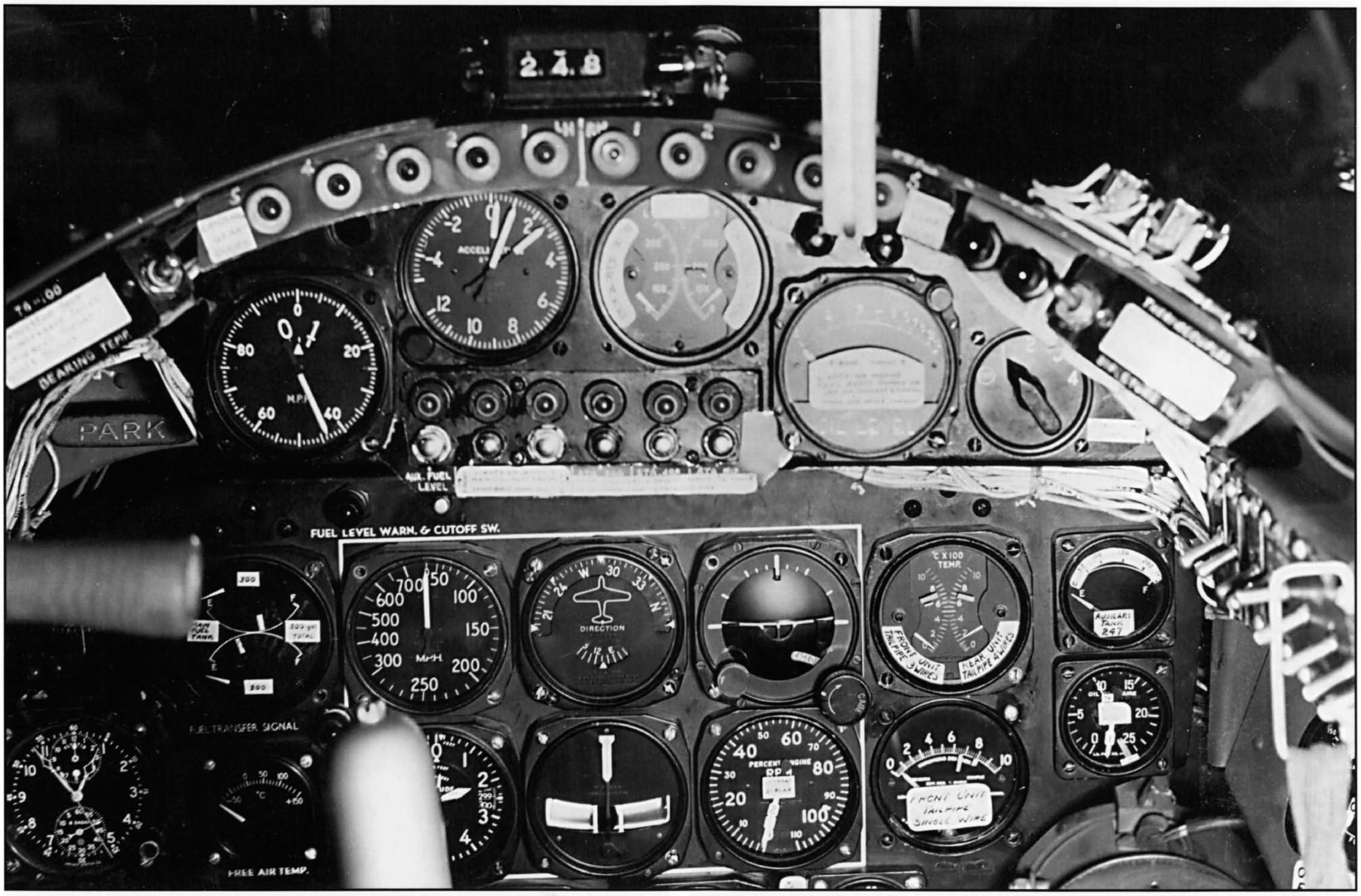
NOSE GEAR

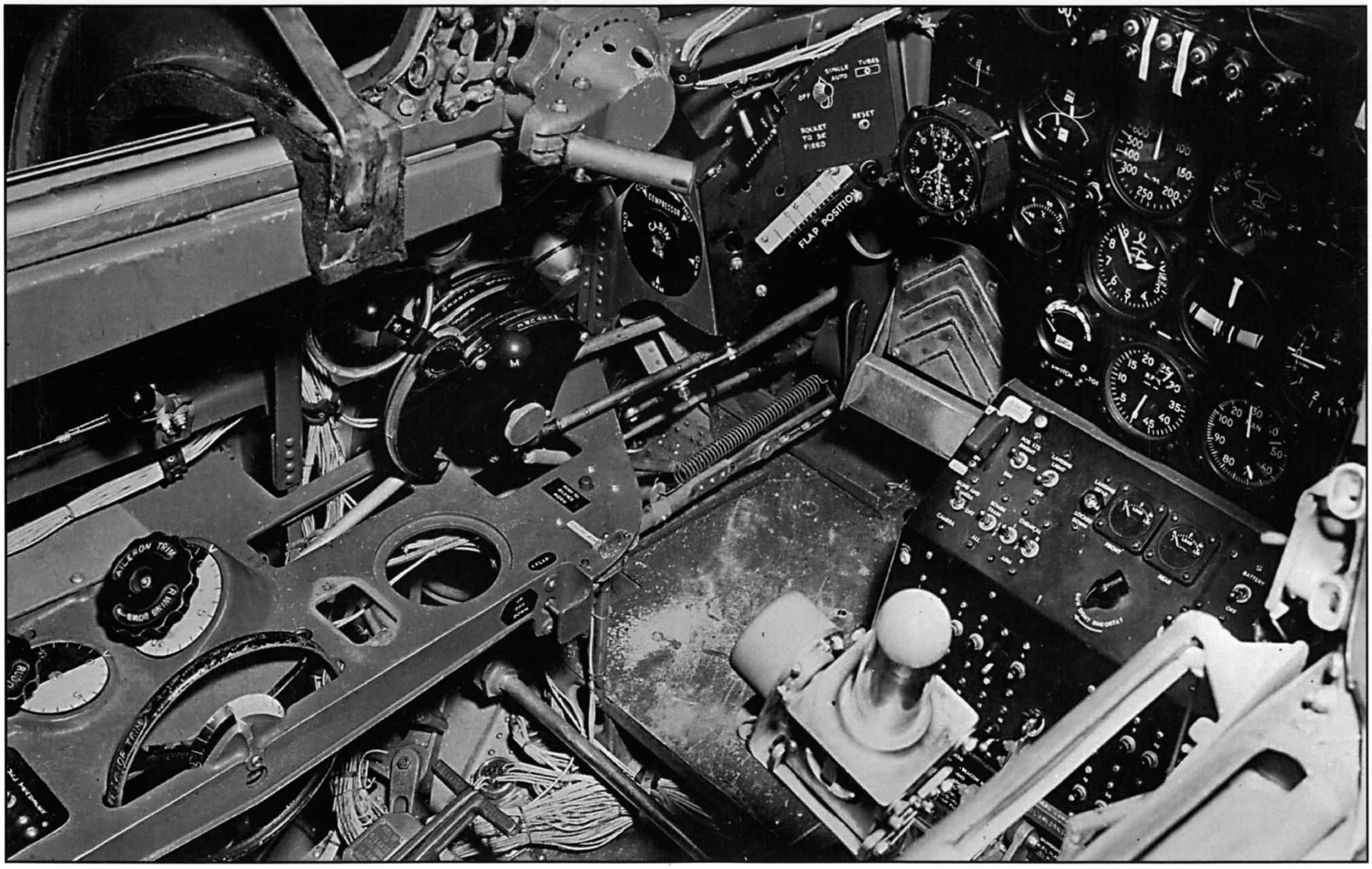


MAIN GEAR

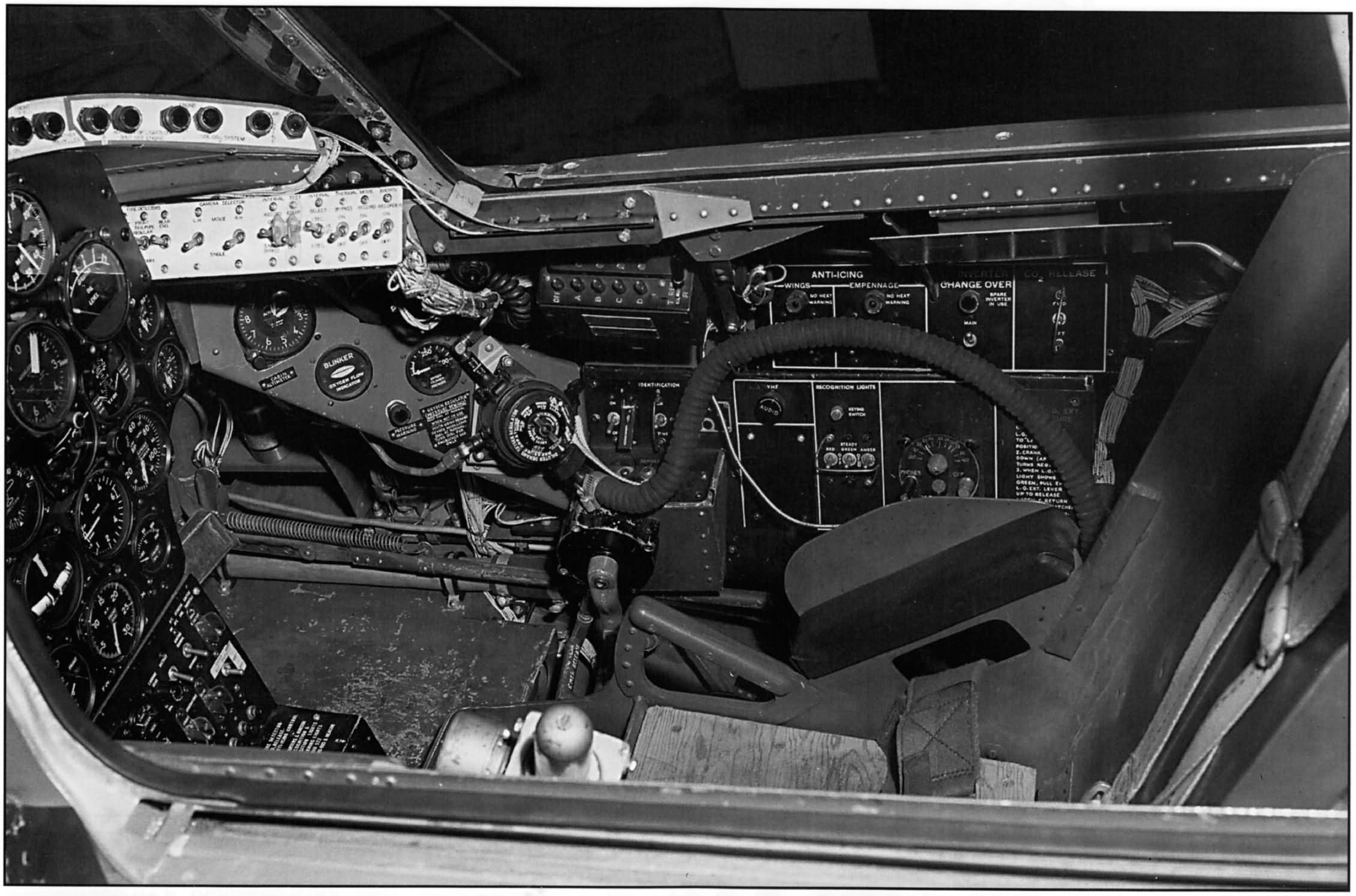


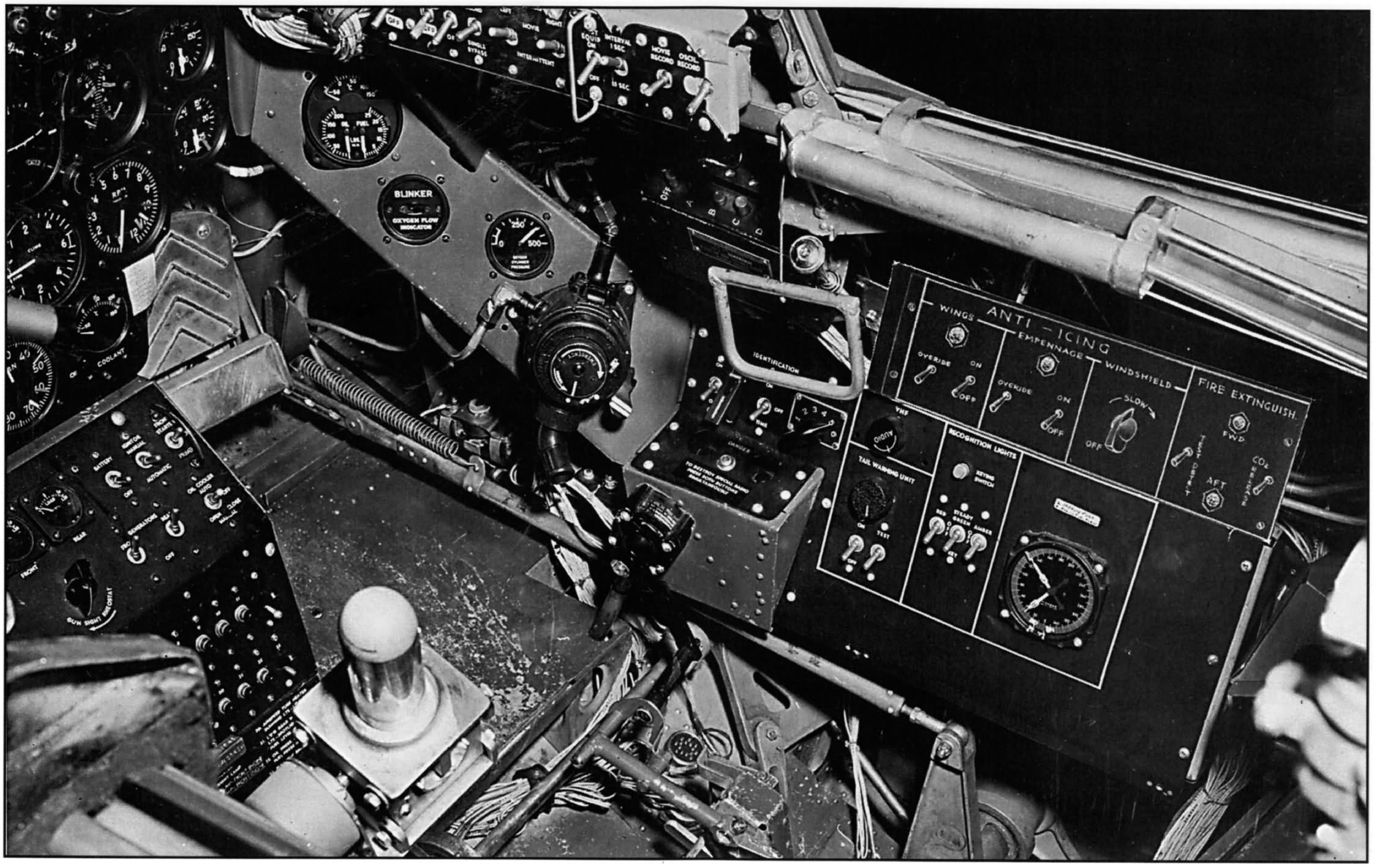
XP-81 INSTRUMENTS AND FLIGHT CONTROLS



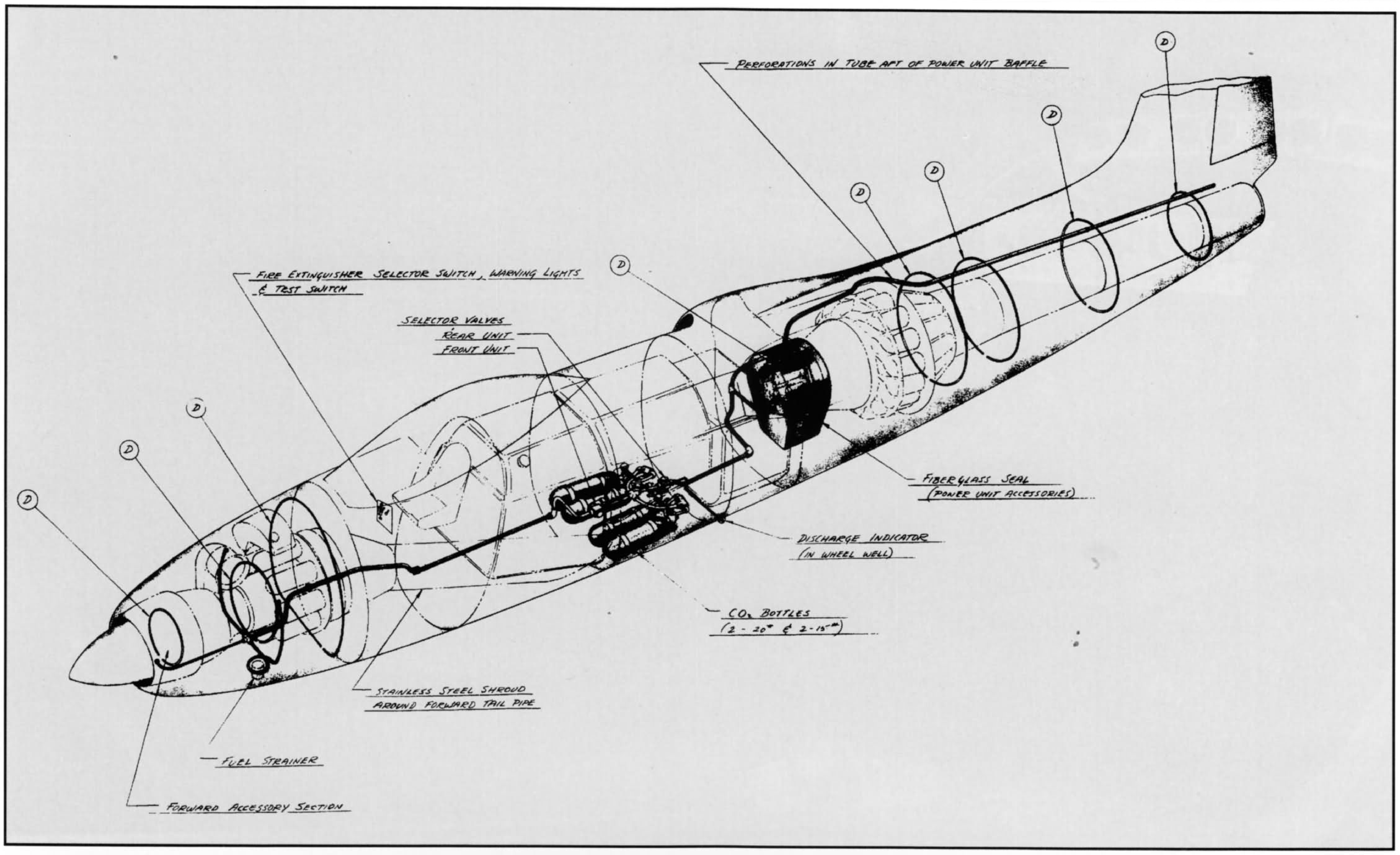


XP-81 PILOT'S RIGHT - HAND CONSOLE

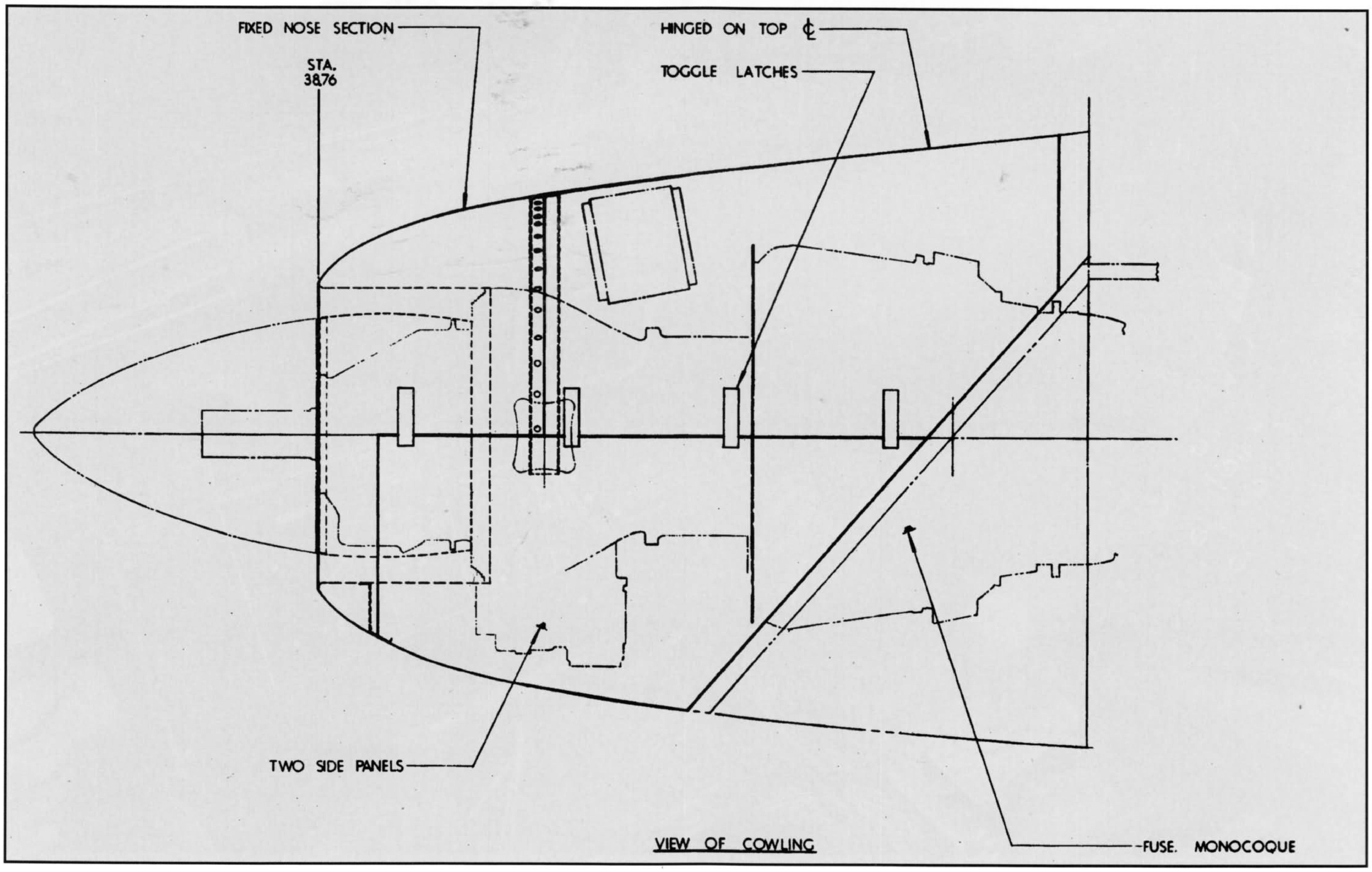




XP-81 FIRE EXTINGUISHER SYSTEM


PERFORATIONS IN TUBE AFT OF POWER UNIT BAFFLE
D
D
D
D
D
FIRE EXTINGUISHER SELECTOR SWITCH, WARNING LIGHTS & TEST SWITCH
SELECTOR VALVES
REAR UNIT
FRONT UNIT
D
D
D
FIBERGLASS SEAL (POWER UNIT ACCESSORIES)
DISCHARGE INDICATOR (IN WHEEL WELL)
CO_2 BOTTLES (2 - 20# & 2-15#)
STAINLESS STEEL SHROUD AROUND FORWARD TAIL PIPE
FUEL STRAINER
FORWARD ACCESSORY SECTION

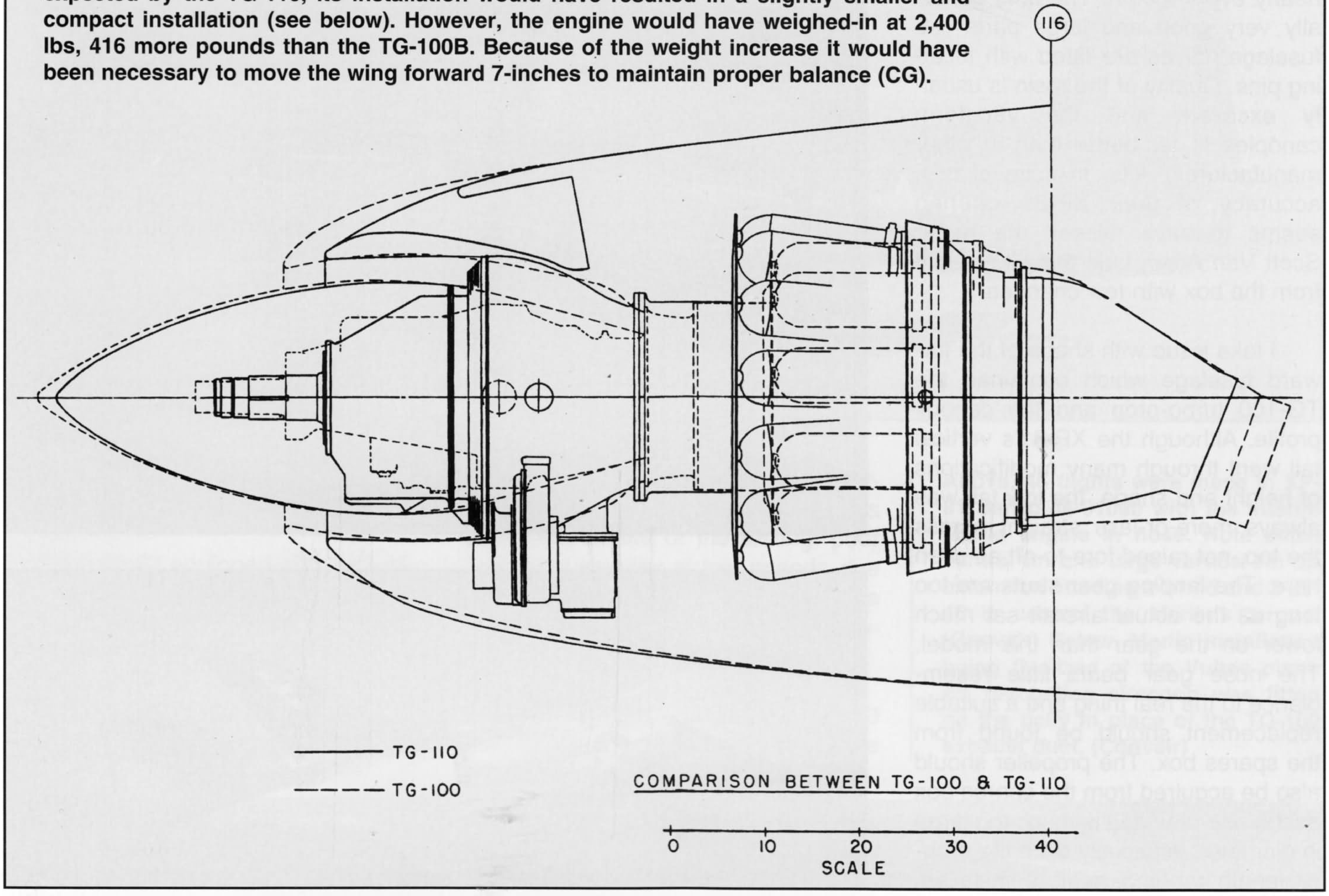
TG-110 ENGINE COWL INSTALLATION



VIEW OF COWLING

COMPARISON BETWEEN TG-110 AND TG-100 INSTALLATION

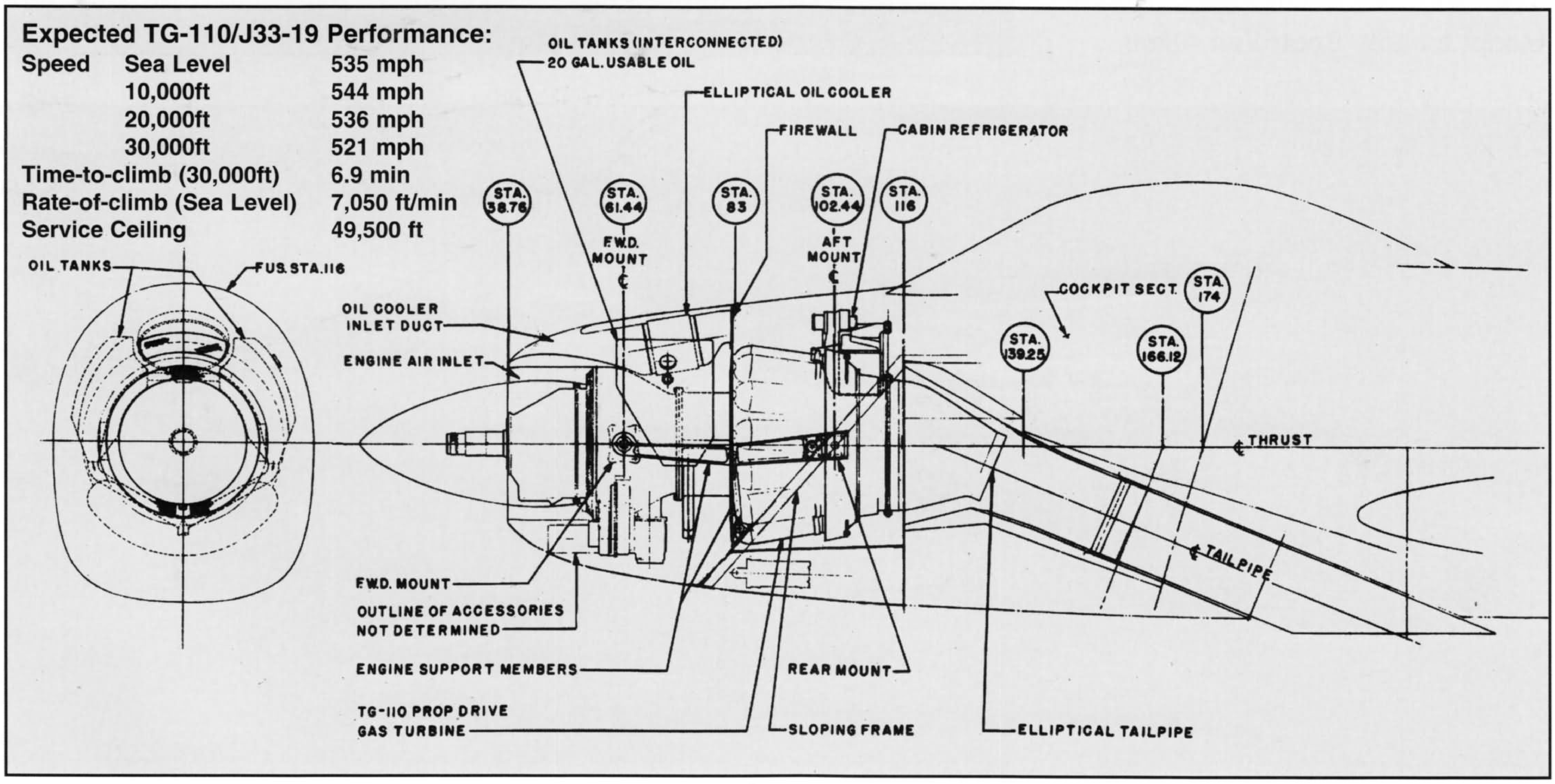
Even though a significant increase in shaft horsepower (1,020 shp) over the TG-100B was expected by the TG-110, its installation would have resulted in a slightly smaller and compact installation (see below). However, the engine would have weighed-in at 2,400 lbs, 416 more pounds than the TG-100B. Because of the weight increase it would have been necessary to move the wing forward 7-inches to maintain proper balance (CG).



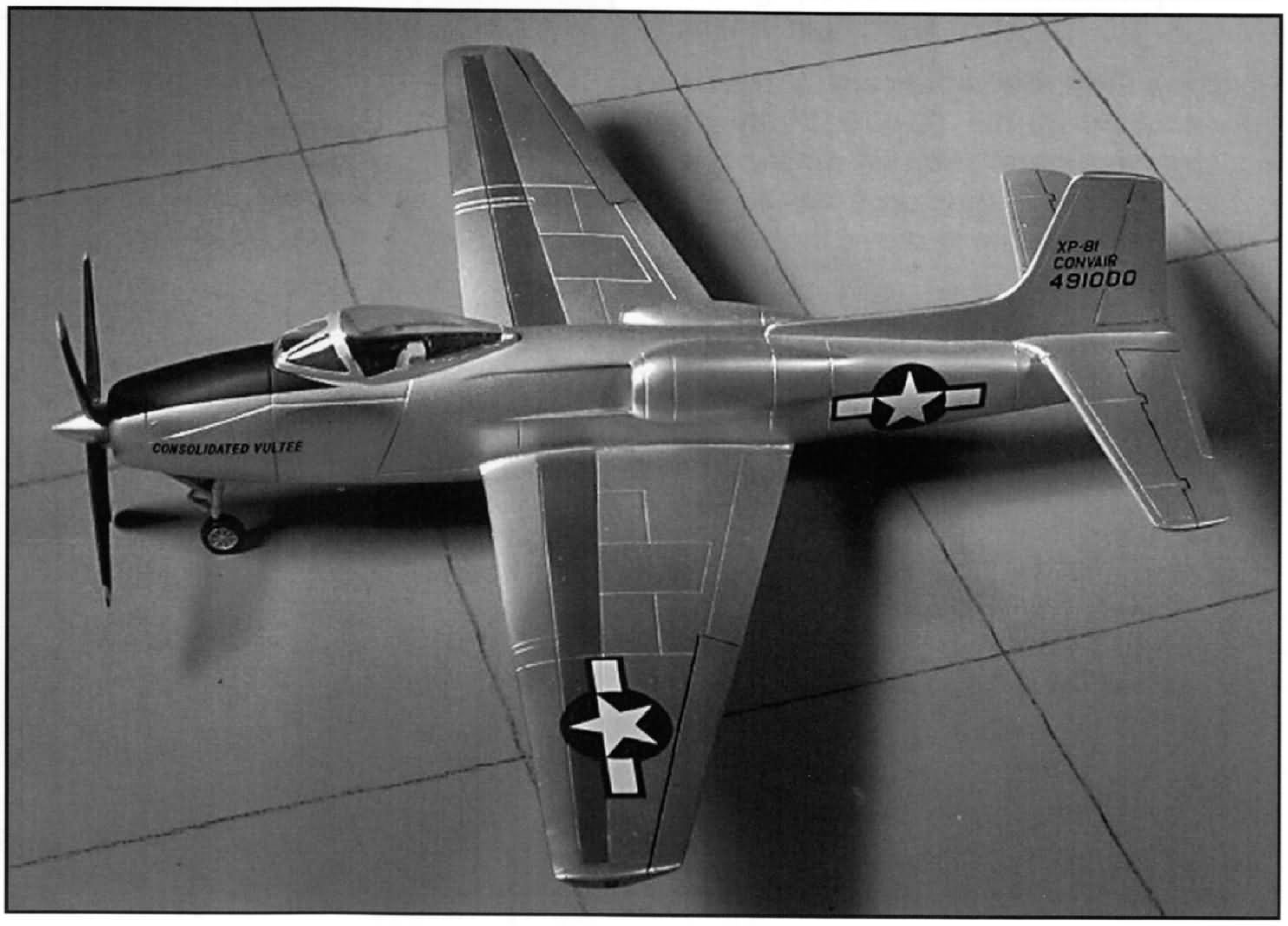
TG-110 INSTALLATION

Expected TG-110/J33-19 Performance:

Speed	**Sea Level**	**535 mph**
	10,000ft	**544 mph**
	20,000ft	**536 mph**
	30,000ft	**521 mph**
Time-to-climb (30,000ft)		**6.9 min**
Rate-of-climb (Sea Level)		**7,050 ft/min**
Service Ceiling		**49,500 ft**

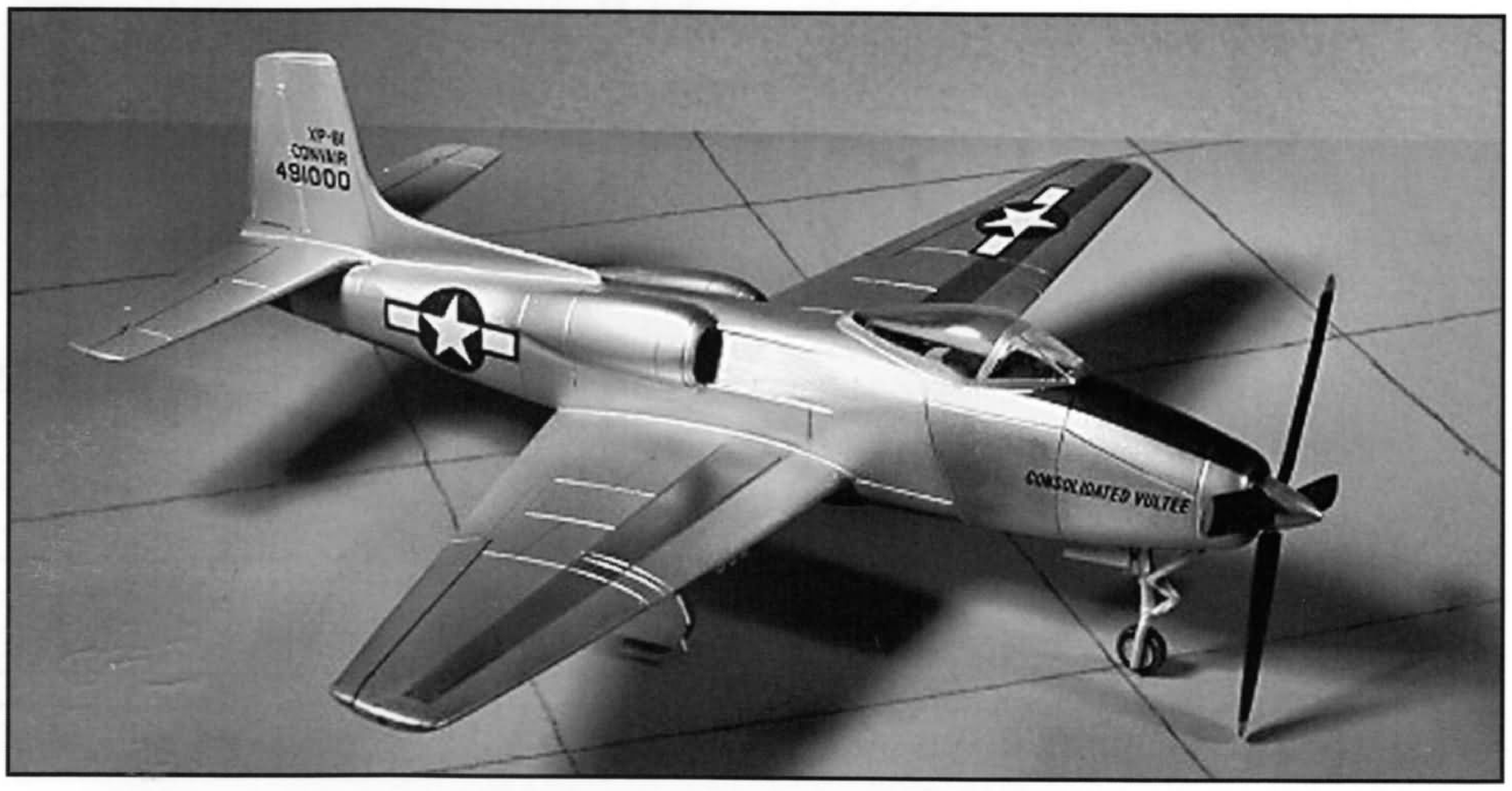


RESIN ANIGRAD 1/72 SCALE XP-81 KIT

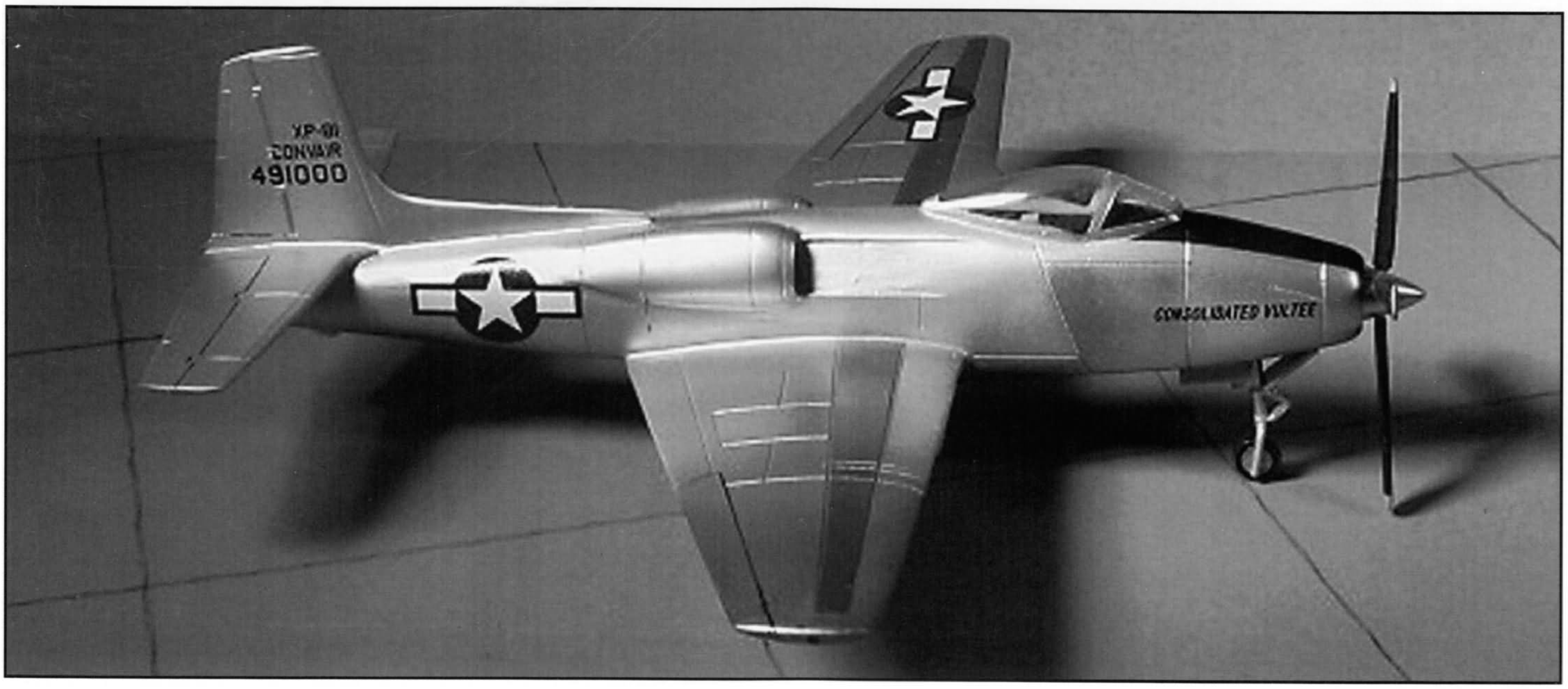


The prolific Anigrad company produces a new resin kit in 1/72 scale nearly every month. The fit is generally very good and large parts like fuselage halves are fitted with locating pins. Quality of the resin is usually excellent and the vacuform canopies fit far better than in other manufacturers' kits. In spite of this, accuracy of their XP-81 offering seems to have missed the mark. Scott Van Aiken built this kit straight from the box with few changes.

I take issue with shape of the forward fuselage which contained the TG-100 turbo-prop and the canopy profile. Although the XP-81's vertical tail went through many modifications of height and shape, the low tail was always more-or-less straight across the top, not raised fore-to-aft as seen here. The landing gear struts are too long as the actual aircraft sat much lower on the gear than this model. The nose gear bears little resemblance to the real thing and a suitable replacement should be found from the spares box. The propeller should also be acquired from the spares box as the one provided is much too large in diameter, especially once the proper length landing gear is installed. Steve Ginter.



Model built by Scott Van Aiken



By Luis Santos

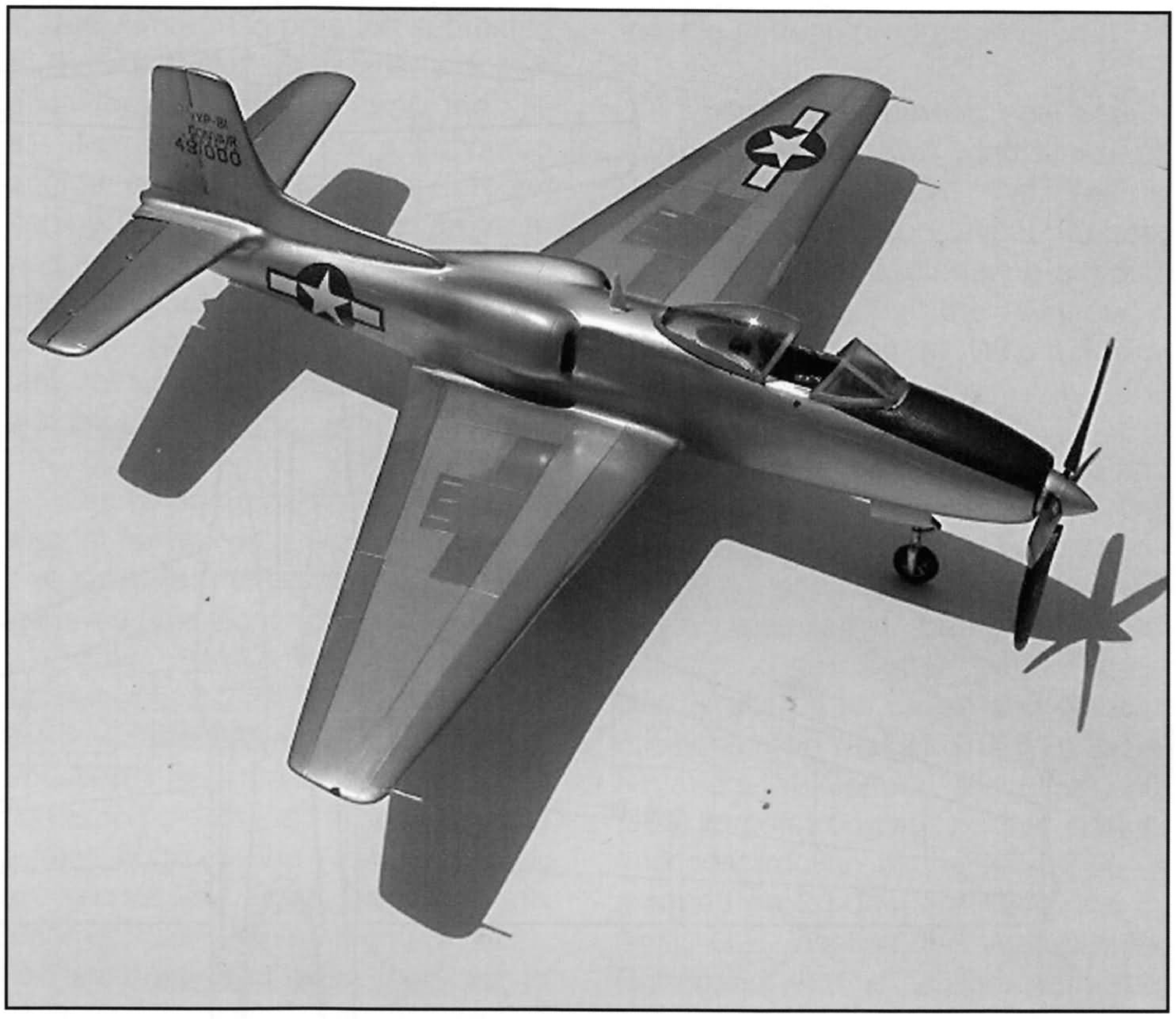
XP-81 VACUFORM 1/72 SCALE KR KIT

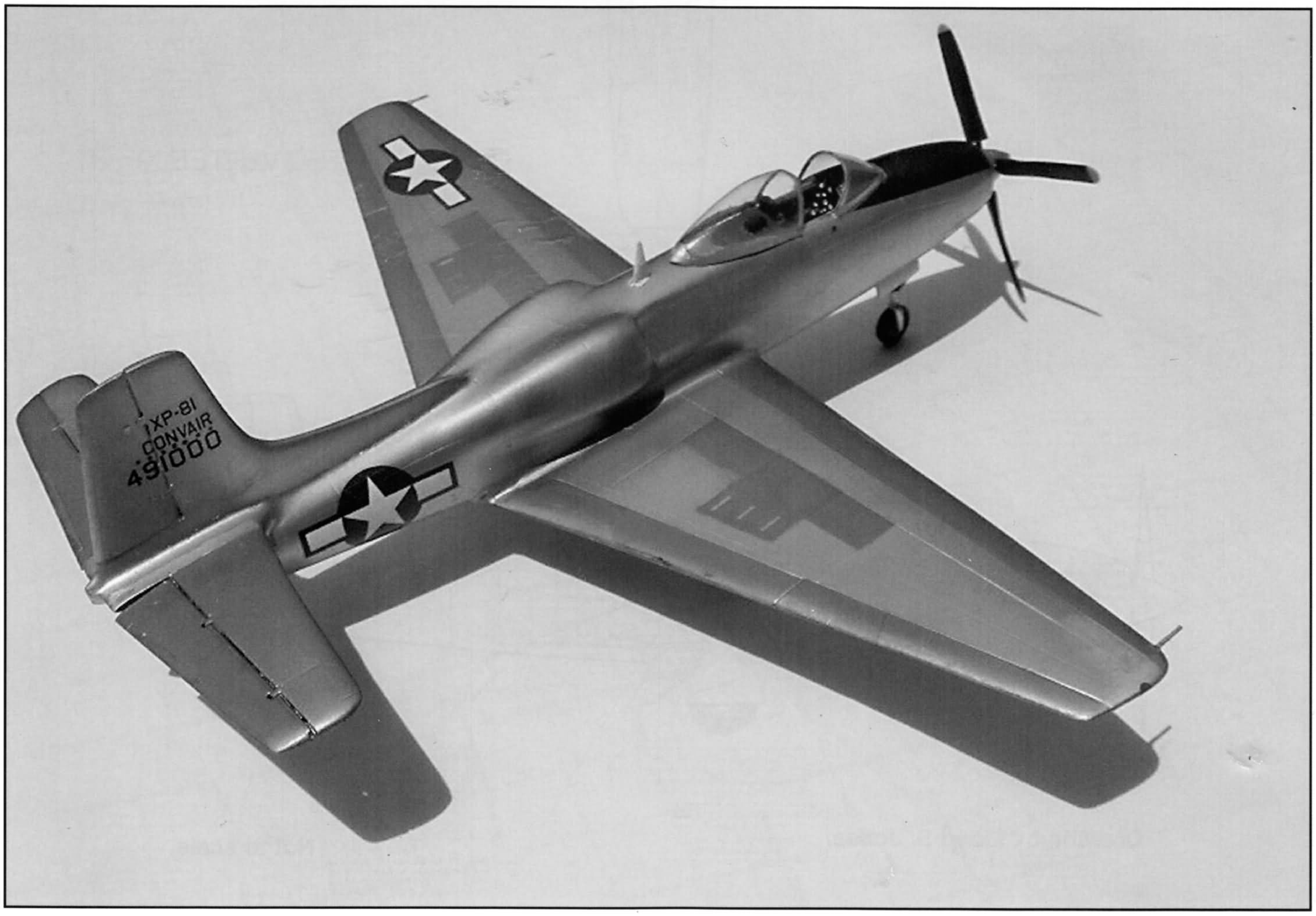
The K/R 1/72 scale kit consists of 15 heavy-gauge vacuformed plastic pieces with scale drawings, including the cockpit arrangement. The kit builds easily and appears to be true to scale. The only feature I found in need of improvement was the scribing as it is barely visible on the model.

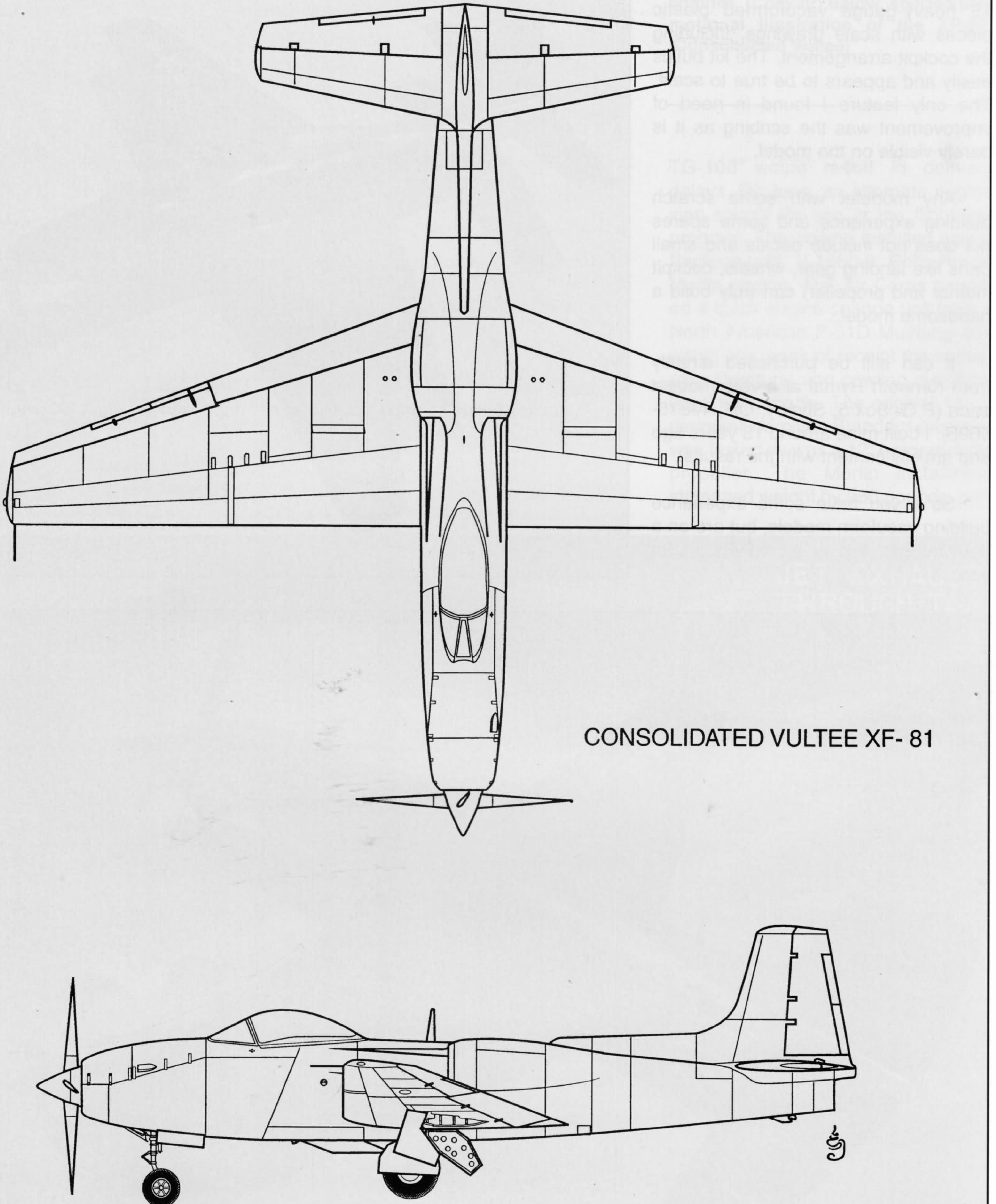
Any modeler with some scratch building experience and some spares (kit does not include decals and small parts like landing gear, wheels, cockpit interior and propeller) can truly build a handsome model.

It can still be purchased directly from Kenneth Rymal at a very modest price (P.O. Box 5, Shelby, OH, 44875-0005). I built mine around 15 years ago and am still content with the results.

So if you have some experience building vacuform models, but are on a tight budget, this is the XP-81 kit for you.







CONSOLIDATED VULTEE XF- 81

Drawing by Lloyd S. Jones.

Not to scale.

The XP-81 was the only U.S. purpose built turbo-prop / turbojet composite powered fighter built and tested. However, additional test vehicles followed by converting existing airframes. The first was the Ryan XF2R-1 Darkshark which first flew in November 1946 and used the TG-100 engine like the XP-81. In the 1950s the Air Force revisited the concept with the McDonnell XF-88B Voodoo and the Republic XF-84H Thunderscreech. The XF-88B (see Air Force Legends #205) first flew on 14 March 1953 and had an XT38 turbo-prop in its nose. The XF-84H first flew on 22 July 1955 and used the XT40-A-1 turbo-prop. These aircraft were very useful in the development of the modern turbo-prop and propeller systems but were never intended for combat.

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Steve Ginter, 1754 Warfield Cir., Simi Valley, California, 93063

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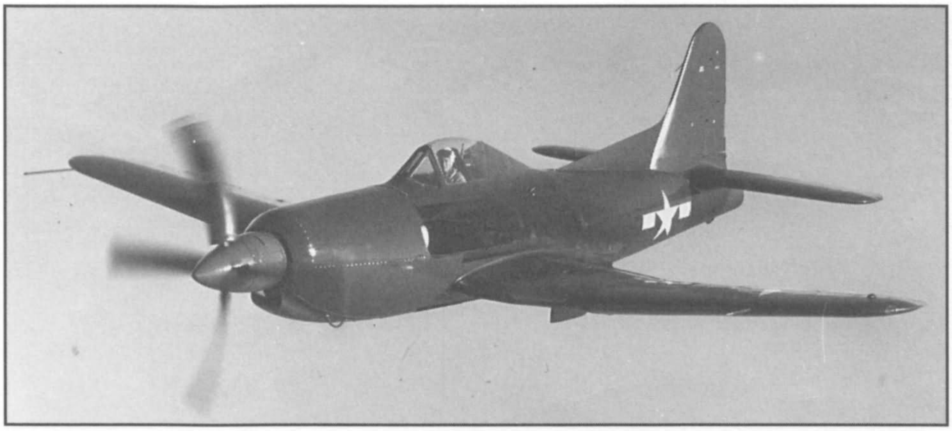
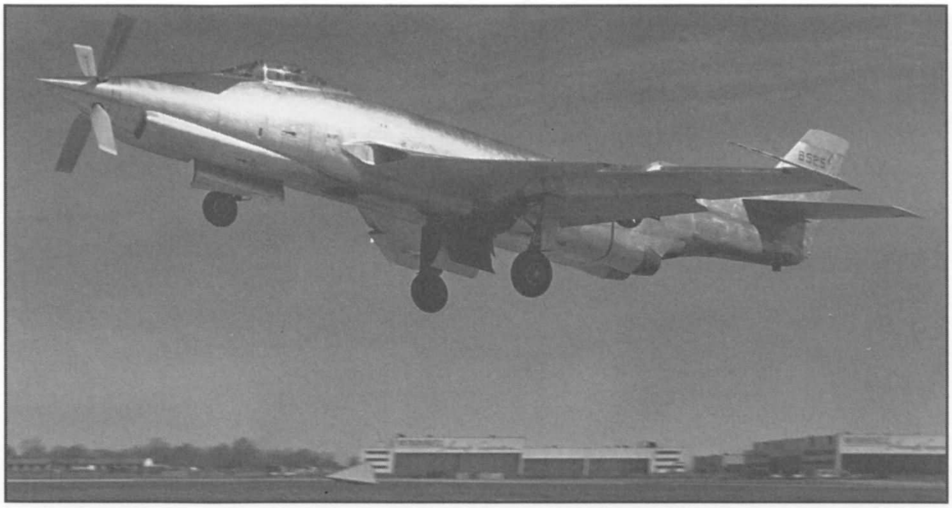
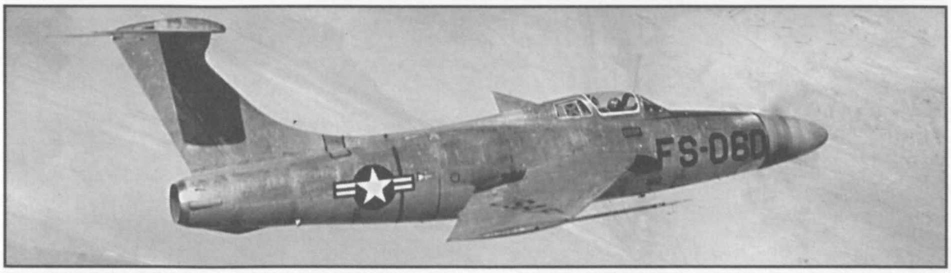
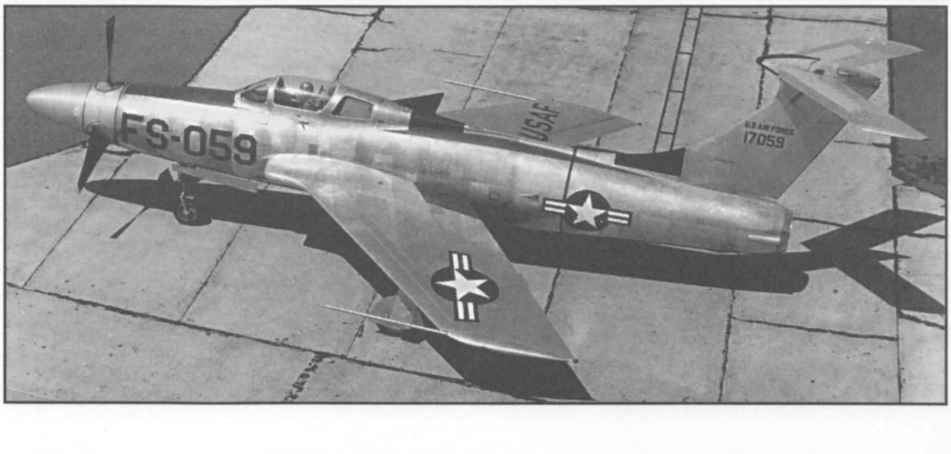
CONTRIBUTORS: Mike Herrill; Lloyd Jones; Wayne Morris; Dr. Raymond Puffer (Air Force Flight Test Center History Office), Edwards AFB; San Diego Aerospace Museum (SDAM); Luis Santos; Scott Van Aiken; and Nick Williams.



Above, the Navy's turbo-prop / turbojet research fighter tested during the same time period as the XP-81 was the Ryan XF2R-1. It was developed from the FR-1 piston / turbojet composite fighter developed and put into production at the end of WWII to shoot down Japanese Kamakazies. It too was powered by a TG-100. (National Archives) Below, the McDonnell XF-88B Voodoo takes off from St. Louis, MO, for a test flight under turbojet power. The XT38 turbo-prop would be started at altitude. (McDonnell) Below middle, XF-84H #2 (060) in flight. (AFFTCHO) Bottom, the Republic XF-84H #1 (059) prior to a test flight with its big XT40 engine. (via Wayne Morris)







XP-81
CONVAIR
491000
CONSOLIDATED VULTEE